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Gold Mining in Bolivia

By Francis Church Lincoln*

SYNOPSIS—Bolivia, once a source of much of the Inca gold, has today but two active gold mines, the Olla de Oro and the Incaoro. Four other lode mines were recently explored; most of the gold lodes of Bolivia have been worked either by Spaniards or Indians. No placers are regularly operated, though recently several have been under investigation.

The ancient golden wealth of Bolivia came mainly from its placers, but attempts to work the famous old placers by modern methods have so far met with the most disheartening failure. The Chuquiaguillo placer near La Paz was worked successfully for a time by a German company under the management of J. A. Sedlmayr, but when it was taken over by an American company it failed and was sold at public auction. An English company known as the Incahuara Gold Dredging Co. put in a dredge on the Kaka river at enormous expense only to find that the ground would not pay. An Englishman named Biber erected an extensive hydraulic plant near the town of Yani, but met with an unfortunate end just as he was beginning to operate it. Officially he committed suicide because of the disappointing result of his first cleanup, but rumor says he was murdered. A letter published in an American mining journal in 1912 caused a rush of several hundred American prospectors to Bolivia to seek gold on the Tipuani river where the Spaniards and the Portuguese had met with much success. They found gold, but in deposits of such a character that they were unable to work them at a profit. These failures by no means prove that there are no good placer gold mines in Bolivia, but rather that great care and good judgment should be exercised in the selection and operation of properties. No gold placers of importance are in regular oper-

The Incaoro Camp on the Eastern Slope of Bolivia

The Incaoro mine is at an elevation of 13,650 ft., and is about 117 miles northeasterly from La Paz. The trail crosses four passes at an altitude of over 15,000 ft.

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ation in Bolivia. A few Indians are working irregularly upon the Chuquiaguillo and other famous old placers, the Amy placer of the Incaoro Mines Co. is being prospected, and a drainage tunnel is being run on the Chungamayo (Ten Rivers) property to the south of La Paz. With these exceptions, the gold-placer industry of Bolivia is at a standstill, having never regained its former importance. Bolivia will yet produce considerable placer gold, but it is to her lodes that she must look mainly for the gold supply of the future.

Two Active Lode Mines

There are at present two producing gold mines in Bolivia, the Olla de Oro (Pot of Gold) and the Incaoro (Inca Gold). Both were worked by the ancient Spaniards and both were relocated in recent years by David G. Bricker, formerly of Butte, Mont. The Olla de Oro mine was found first and sold to an English company, Mr. Bricker remaining at the mine as manager. Disagreements between the directors and Mr. Bricker finally resulted in his leaving the Olla de Oro and seeking another mine. He then found the Incaoro mine which he sold to the Incaoro Mines Co. of Delaware, of which he is vice-president and general manager.

While there are no other gold mines in operation in Bolivia at present, prospecting is fairly active and development work was recently in progress on four properties; the Kakabarranca; the Suri; the Huancapampa; and the Caracote. There are also repeated rumors of the reorganization of the Amaya Pampa mine which is now shut down. The Rosario mine at Araca has a large low-grade vein which was recently worked on a small scale for a number of years. The Amaya Pampa (Death Meadow) mine in the province of Chayanta, department of Potosí, was in operation from 1893 till December, 1911. Its mill consisted of six small stamps with a capacity of eight tons per day and a cyanide plant with a capacity of 20 tons per day. It is altogether possible that the Rosario and Amaya Pampa operations failed because of the small scale upon which they were conducted. It seems probable that many good gold lodes will be discovered, and that most of these will be found to have been worked by the ancient Spaniards.

Distribution of Gold Deposits

The principal gold belt of Bolivia extends from Suchez on the Peruvian border southward through the center of the department of La Paz and then swings eastward through northern Cochabamba into the department of Santa Cruz ending at Concepción near the Brazilian boundary. The two producing gold mines, the first three of the four lode properties mentioned above as being under development, and all three of the placer properties similarly noted, are situated in this belt.

South of this, in the department of Oruro and in the southern part of Cochabamba and northern part of Chuquisaca, silver is found but there is practically no gold. Further south, a second and more irregular gold belt begins at Amaya Pampa in northern Potosí and extends southward throughout the department with an easterly extension on the Camblaya river which forms the boundary between the departments of Chuquisaca and Tarija. In this belt are situated the Amaya Pampa mine and the Caracote prospect.

The Old Olla de Oro Camp, near Umabamba, Bolivia, 43 Miles East of La Paz

The old mill has been twice wrecked by flood, though ancient landmarks indicated that nothing of this kind had occurred since early Spanish times. A new mill was erected last June about two miles from the old site; new Hardinge mills have been added to bring the capacity up to 80 tons per day.

All of the gold lodes mentioned occur in a black slate containing occasional interbedded strata of quartzite. This was classified by d'Orbigny as of Silurian age, but so far as I am aware no fossils have been found in this slate at any of the mines or prospects. While the structure of the various deposits differs greatly, the contents are on the whole similar. In all the veins, free gold occurs in quartz and is frequently visible to the naked eye. Base gold is also present in pyrite, arsenopyrite, stibnite and pyrrhotite, but except in the case of the Caracote prospect the sulphides are small in quantity and their gold content while high is economically of minor importance.

The Olla de Oro Mine

The Olla de Oro (Bolivia) Mine, Ltd., has its home office at 33 St. Swithin's Lane, London, E. C., and its

local office in La Paz. George Easley, an American mining engineer, is Bolivian manager. The mine is situated on the Umabamba river, 43 miles by fair mule trail easterly from La Paz. The trail crosses a divide 13,000 ft. in height and then descends into Palca cañon to the town of Palca, 18 miles from La Paz. A second divide, 14,150 ft. in altitude, must then be crossed to the Umabamba river; the new Olla de Oro camp is at an elevation of 9000 ft.; the old camp is on the mountainside a mile further and 1200 ft. higher.

The country rock is the Silurian of d'Orbigny, a nonfossiliferous black slate with a few interstratified beds of quartzite. The ore deposits are of the saddle-reef type, resembling those of Nova Scotia and of Bendigo, Australia, save that at the Olla de Oro the saddles have been faulted near their crests leaving little more than half of them available for exploitation. The reefs are composed mainly of quartz in which free gold occurs, frequently in pieces visible to the naked eye. Gold-bearing pyrite, pyrrhotite and arsenopyrite also occur in the reefs.

Mining is done largely by contract. Holes are paid for at the rate of $0.016 (4 centavos) per inch when in slate, and $0.032 per in. when in quartz. Drifting and raising cost $16 (40 bolivianos) per linear meter, everything but the steel being furnished by the contractor. Miners who are not working on contract receive from $0.80 to $1.20 per day; helpers $0.60 to $0.80; and outside men $0.60 and under.

There is a 50-ton amalgamating mill at the old camp, shown in the illustration. This mill has twice been wrecked by a flood, although ancient landmarks indicated that nothing of the kind had occurred since early Spanish times. The mill machinery consists of an 8x15-in. Blake crusher, a 4½-ft. Hardinge conical ball mill, a 6-ft. Hardinge conical pebble mill and a revolving screen, all operated by a 3-ft. Pelton waterwheel. Amalgamation is carried on inside the pebble mill as well as upon amalgamating plates outside. The ore plates about $5 per ton, and the tails run about $2.50, mostly in the sulphides. In the mill now under construction at the new camp, provision is being made to save the gold in the tails in the form of concentrates. The new mill is also to be of the Hardinge type but is to have double the capacity of the old one. It will be equipped with two ball mills, two pebble mills, four revolving screens, one Wilfley table and one Deister slime table, all operated by a water turbine.

The Incaoro Mine

The Incaoro Mines Co. is an American concern incorporated in the state of Delaware with a capital of $1,000,000. Horace G. Knowles, formerly U. S. Minister to Bolivia, is president of the company and David G. Bricker is general manager.

The mine is located at Pallaya, near the town of Yani, and is 117 miles by wagon road and mule trail northeasterly from La Paz. The wagon road goes as far as the town of Achacachi on the shore of Lake Titicaca, 12,500 ft. above the level of the sea. Thence the trail goes to the town of Sorata on the Atlantic drainage slope at an elevation of 8500 ft., and then crosses four passes all over 15,000 ft. in height, to the mine at 13,650 ft. The camp is situated in a little glacial valley shown in the engraving on the first page.

The country rock is a nonfossiliferous black slate containing occasional strata of fine-grained gray quartzite and is in every respect similar to that at the Olla de Oro mine. This rock has been folded and highly contorted, and the ore deposits, which are bedded veins, have been bent and twisted with it. The surface has since been subjected to intense glacial action. As a result of these two factors, some ore deposits of extremely peculiar shapes have been developed. In some instances the bedded veins are evidently nothing more than quartzite strata which have in part been replaced by vein matter, and it is possible that all the veins are of this type although no quartzite has as yet been found in the principal vein. The chief vein mineral is quartz, with which occur a little white mica and less native gold, while more rarely gold-bearing arsenopyrite, pyrrhotite and pyrite make their appearance in the veins. The gold is frequently visible to the naked eye, both in the quartz and in the slate adjacent to the veins.

About 100 Aymará Indians are employed in the mine at prices ranging from $0.16 (40 centavos) for the smallest boys to $1.60 (4 bolivianos) for mine captains. A small amount of work is done by contract. Holes in quartz are then paid for at the rate of $0.02 per in. in slate and $0.04 per in. in quartz; while drifting and crosscutting are paid for at the rate of $12 per linear meter.

The New Incaoro Mill

The Incaoro mill is shown in one of the accompanying engravings. It is a 50-ton amalgamating mill of the Hardinge type run by a Pelton waterwheel. The installation consists of a bar screen, jaw crusher, 4½-ft. conical ball mill, 6-ft. conical pebble mill and six amalgamating plates. The mill is at present running on ancient Spanish fillings and pillars which plate about $5 per ton, the tailings containing little gold. However, as a concentrate running from $16 to $1500 per ton can be made at slight extra cost, concentrating tables are soon to be installed. The capacity of the mill is also about to be doubled by the addition of another unit.

Five Lode Prospects

The Bolivian Development & Exploitation Co. is a Delaware corporation capitalized at $1,000,000. Horace G. Knowles is president and Luis Zalles of La Paz is vice-president. This company, for which I was formerly resident engineer, is interested in the development of the Kakabarranca, Suri, and Caracote gold prospects.

The Kakabarranca prospect is an ancient Spanish mine, recently relocated by Dr. L. E. Benson of Los Angeles.

It is situated 111 miles by good trail easterly from La Paz, near the town of Coropata. The trail to the mine crosses a pass over 15,000 ft. in height and a river at 4000 ft., the prospect itself being at an elevation of 7900 ft. above sea level. The country rock is the same black nonfossiliferous slate noted at the two producing mines but at Kakabarranca the quartzite strata are missing. The ore deposits are parallel fissure veins with steep dips. The slaty cleavage also dips steeply but the veins cut it cleanly, though at small angles. The vein filling is quartz in which native gold, at times visible to the naked eye, is found. Rarely, a little pyrite and arsenopyrite are encountered. The property is being developed by means of a tunnel on the vein which will probably strike the main ore shoot below the ancient Spanish workings.

One of the few new gold prospects opened in Bolivia is that near the town of Suri. This town is 90 miles by wagon road and good trail from Eucaliptus station on the Antofagasta & Bolivia Ry. The wagon road extends for 52 miles from the railroad to Caluyo stage station where the trail begins. This crosses Quimsa Cruz pass at an altitude of over 15,000 ft. to the town of Quime and follows down the Quime river till opposite the town of Inquisivi, where it crosses the foothills of the main range of the Andes to Suri. The geology is similar to that at Potosí branch of the Antofagasta & Bolivia Ry. The trail to this prospect passes through the town of Porco, two miles from the railroad, on past the historic Porco mines to the village of Quimsapalca, 15 miles beyond Porco, and thence to Caracote camp at an elevation of 11,950 ft. This camp is in the southern gold belt of Bolivia. The country rock consists of slates and quartzites similar to those at the mines and prospects in the northern belt. The veins follow roughly the stratification of the slate, but at times cut across it and are evidently associated with fissures. The vein filling consists of quartz, stibnite and gold. The fillings vary from nearly pure quartz to nearly pure stibnite, changing from one to the other within short distances or being composed partly of one and partly of the other lying side by side. The gold is free and frequently visible to the naked eye in the quartz, but base and invisible in the stibnite. The prospect was worked to a slight extent by the Spaniards, and recently a little development work has been carried out and trial shipments of a ton of the quartzose ore and a ton of the antimonial ore were sent to New York. The ores contained 0.72 oz. and 1.15 oz. of gold and 6% and 56% of antimony, respectively.

The Amaya Pampa mine in the southern belt has been shut down for the last two years, but the workings are so

THREE BOLIVIAN GOLD PROSPECTS NOW UNDER DEVELOPMENT

(1) Near the town of Suri, a "new" gold prospect is being opened (2) Huancapampa on the steep slopes of Mt. Chilcoya (3) Caracote, a gold-antimony prospect

the Kakabarranca prospect, save that the principal vein instead of being nearly perpendicular lies nearly flat. The chief vein filling is white to glassy quartz containing native gold. At the surface a rich shoot containing pyrite, chalcopyrite and galena occurred, and native gold was found intergrown with the galena.

The Huancapampa prospect is situated on the steep slopes of Mount Chilicoya. It is three miles in a northerly direction from the town of Palca which is on the trail to the Olla de Oro mine. The mine is an ancient one, at present owned by Francisco Valentie of La Paz. The country rock ranges from black slate to mica schist. The ore deposits are quartz veins parallel to the slaty cleavage. These veins are narrow and have no great extent, either laterally or in depth, but they are numerous and frequently rich, free gold being often visible to the naked eye. Señor Valentie recently put half a dozen Indians to work cleaning up the mine preparatory to commencing development work.

Juan M. Saracho, vice president of Bolivia, owns some interesting gold-bearing antimony veins at Caracote, 35 miles by fair trail from Agua Castillo station on the numerous that it is impossible to exclude the Indians and a number of them are "high-grading" in the mine at present. The ore deposits are gold quartz veins in black slate.

PLACERS UNDER DEVELOPMENT

The Amy placer of the Incaoro Mines Co. is situated a short distance from the Incaoro mine between the mine and the town of Yani. It was worked by the Spaniards but still contains considerable areas of good unworked ground. The placer lies in a glacial valley. The ground is at present being prospected.

The Cía. Minera Chungamayo was organized in Hamburg in 1911 to work an ancient placer located by Max Angermann in 1910. The Chungamayo placer is situated on the eastern slope of the main range of the Andes, six miles up stream from the town of Lambate, province of Sur Yungas, department of La Paz.

The famous Chuquiaguillo placer near La Paz, which was recently purchased at public auction by Benedicto Goytia, president of the Bolivian Senate, is being worked on a small scale by Indians.

The Casapalca District, Peru

CASAPALCA CORRESPONDENCE

Although much work in the Casapalca district, Peru, was suspended at the outbreak of the European war, all the operating companies made substantial progress in the first half of 1914. The San Antonio mine, owned by the Sociedad Minera de Huarochiri, was equipped with a small air compressor and drills, development work having shown the orebodies to persist; the mine has yielded a large tonnage of high-grade silver ore in the past and now ships considerable rich ore besides the low-grade ore sent to the Casapalca smelting works; the mine has been connected with Elias Mujica's Americana concentrator in which some of the low-grade ore will be treated in the future. The Cia. de Minas del Carmen is driving a long adit to cut the Carlos Francisco vein 400 ft. below any existing workings; power is now obtained from the Backus & Johnston Co. The Aguas Calientes group of mines, owned by Ricardo Bentin, has been working steadily. The company now has ample power, its 500-hp. hydro-electric plant on the Rio Rimac having been completed late in 1914. The company recently enlarged its mill and is also driving a long adit to develop its orebodies at depth.

The principal mine in the Casapalca district is the Carlos Francisco, operated by the Backus & Johnston Co., which also owns the Casapalca smelting works where most of the ore of this district is smelted. Preparations are now under way to install electric haulage in the Carlos Francisco, as well as electric hoists for the upper levels of the mine. A motor-driven compressor of 1955-ft. capacity, installed late in 1914, furnishes the mine ample compressed air, besides a supply for the smelting works. An aërial tramway was constructed last year for bringing down to the mill a large tonnage of low-grade ore left on the dumps of the upper workings of the mine. This tramway, which is about 6000 ft. long, reaches an altitude of 16,000 ft., being perhaps, the highest tramway in existence. The capacity of the tramway is 15 tons per hour; it is self-operating, in fact, enough power is developed by it to run a crusher and an elevator at its upper terminal.

The Casapalca smelting works has been practically doubled in capacity. The second blast furnace, 52x160 in. at the tuyeres, and the two new stands of 96x150-in. converters have been operating successfully; the 42x264-in. Dwight-Lloyd sintering machine was completed late in 1914. The smelting plant is now practically finished, so far as present conditions require, thus bringing to a close the construction work initiated by the late J. Howard Johnston. The 2000-hp. hydro-electric plant, installed on the Rio Rimac has run successfully and lightning troubles, so severe in the high altitude of Casapalca, proved to be much less formidable than had been anticipated; in 1914, the transmission line was continued to Morococha to furnish power for the extensive interests of the company in that district.

In Morococha, the advent of power from Casapalca, as well as from the Cerro de Pasco company's plant at Oroya, has made it possible to operate the mines in the Morococha district on a much larger scale, as well as at greatly decreased costs. Electric pumps have been installed in the Natividad, Pacchapata and Alapampa mines, and electric hoists in the Victoria and Alapampa. A 2500-cu.ft. air compressor has been installed for the Natividad, and one of 1955-cu.ft. capacity for the mines on the Santa Clara hill, where extensive development work is in contemplation. When conditions return to normal, the output of the Casapalca and Morococha districts will exceed anything recorded of them in the past.

The Assay of Precious Metal Bullion*

The foundation of this paper lies in a comparison of silver determinations in 579 redeposits in the U. S. mint service by cupellation methods, showing such wide differences as to require an extensive examination into the conditions of the determination and the possibility of developing a better method. The silver fineness is obtained by a difference determination, being the difference between 1000 and the gold and base metal present which are obtained by direct determination. Its accuracy is, therefore, dependent upon the accuracy of the two determinations which are actually made. When the net errors of the two actual determinations are opposite, it may happen that the silver figure will be close to the truth, but when they are both on the same side, the error in the silver determination may be large.

Two papers by the author have shown that the inaccuracy of the gold cupellation is often much greater than is generally supposed. In some ordinary bullions it may be one fine or more, while in some cyanide bullions it may rise to three to five fine.

The cupellation for base metal in gold bullion is a ridiculously simple operation and may be described in a few words. The assay sample of the bullion is weighed, wrapped in the proper amount of sheet lead and cupeled, accompanied by the proper proofs, to a button of gold and silver, which is cleaned and weighed. The difference between the weight and the sample taken and the button of gold and silver, when corrected by the proof, is called base metal that has been driven off or absorbed by the cupel. Aside from carelessness, there appears to be but few chances for variation in the operation, but the paper shows that some of these are exceedingly potent.

Tests upon the volatilization of precious metals during actual cupellation are described, which lead to the conclusion that in the vast majority of cases and with the exception of bullion high in copper and certain exceptional classes of bullion, such as those containing arsenic and antimony, the volatilization of precious metals in properly conducted base-metal assays is insignificant.

Many determinations of lead and copper retained by gold and silver assay buttons are given and lead to the conclusion that this is a most important factor in the accuracy of the results. From 0.5 mg. up to 3 mg. of lead per gram of button may be retained by the gold and silver button. The copper was seldom less than 1 mg., and in one instance rose to 20.84 mg. We have no means of controlling the amount of residual lead and copper. It rests entirely in the judgment of the cupeler. When he thinks the lead and copper have been driven off, he removes his assays from the furnace. The figures given

Note—This is the author's abstract of his original paper.
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show that the lead and copper remaining in apparently finished beads cupeled under similar conditions may vary greatly.

The question of the absorption of precious metals by the cupel is thoroughly discussed and the distinction between true absorption and the separation of beads emphasized. Many assays of used cupels are given, often with the screen analysis of the bone-ash from which the cupels were made.

A most excellent illustration of everyday work is supplied by the cupels from three bullions assayed in one of the smaller offices on a day when the writer happened to be examining the institution. The cupel absorptions of gold and silver, in milligrams, were as follows:

	No. 1	No. 2	No. 3
A sample	2.62 2.68	3.75	4.81
B sample	1.63 1.87	3.95	6.03

A bullion 757 fine in gold, 196 fine in silver, and 47 fine in base metal was assayed 8 times in duplicate with a proof between each pair of duplicates and again 8 times in a different cupel and a slightly hotter part of the furnace with the following results:

RESULT OF VARYING TEMPERATURE

Gold and Silver Absorbed, mg.

	1st Run		2nd Run (warmer)		
1st Assay	Proof	2nd Assay	1st Assay	Proof	2nd Assay
1.55	1.71	1.75	2.18	2.26	2.00
1.73	1.88	1.76	2.23	2.36	2.46
1.81	1.82	1.75	2.19	2.41	2.35
1.80	1.88	1.76	2.32	2.44	2.28
2.43	2.47	2.42	2.96	3.11	3.10
2.37	2.66	2.44	3.22	3.26	3.00
2.67	2.66	2.61	3.34	3.28	3.16
2.67	2.62	2.60	3.41	3.60	3.14

The general conditions in one of the largest laboratories in the service are illustrated in the following table, which gives the cupel absorptions in base metal assays on a wide range of bullions:

CUPEL ABSORPTIONS, BASE METAL ASSAYS

Gold Absorbed mg.	Silver Absorbed mg.	Total Absorption mg.
0.97	0.78	1.75
0.75	1.07	1.82
1.13	0.85	1.98
1.58	0.58	2.16
1.17	1.04	2.21
1.06	1.25	2.31
1.34	0.97	2.31
0.91	1.43	2.34
1.01	1.38	2.39
1.09	1.36	2.45
0.28	2.25	2.53
1.03	1.51	2.54
1.23	1.36	2.59
0.90	1.72	2.62
1.08	1.73	2.81
1.12	1.78	2.90
0 81	2.24	3.05
1.02	2.13	3.15
1.65	1.57	3.22
1.75	1.76	3.51
1.64	1.91	3.55
1.70	1.94	3.64
1.51	2.15	3.66
1.05	2.62	3.67
1.81	1.97	3.78
1.58	2.24	3.82
1.95	1.88	3.83
1.63	2.36	3.99
0.42	3.59	4.01
1.93	2.10	4.02
2.10	2.15	4.25
2.24	2.27	4.51
2.49	4.32	6.81

As a general illustration of what may occur with a rain of microscopic beads, accompanied in some cases by separate beads, six such cupels showed the following results:

METAL RECOVERED FROM BEADED CUPELS

Gold mg.	Silver mg.	Total mg.
3.55	2.49	6.04
2.98	3.13	6.11
3.45	2.68	6.13
3.28	2.34	5.62
2.81	4.87	7.68
2.16	4.56	6.72

Five base-metal assays each were made on two high-grade bullions, accompanied by two proofs. The cupels were arranged in the muffle in three rows of four with the proofs in Nos. 2 and 3 of the middle row. The cupels showed the following absorptions:

ABSORPTION WITH HIGH-GRADE BULLION

Composition	Cupel Absorptions Gold mg.	Silver mg	Total mg.
No. 1 Bullion			
Gold 898.5 fine	1.86	1.08	2.94
Silver 89. fine	1.97	1.02	2.99
Base 12.5 fine	2.21	1.10	3.31
	2.54	1.19	3.73
	2.48	1.19	3.67
No. 2 Bullion			
Gold 895.5 fine	2.02	1.03	3.05
Silver 98.5 fine	1.74	1.09	2.83
Base 6 fine	2.12	1.24	3.36
	2.42	1.30	3.72
	2.60	1.29	3.89
Proofs			
Gold 450 mg	2.22	1.06	3.28
Silver 45 mg	2.36	1.18	3.54

Many more sets of cupel assays are given and they lead to the inevitable conclusion that variations in the cupel absorptions even under substantially identical conditions open the way for large variations in the results. It is generally assumed that the proof assays will correct this and other variations, at least approximately, but if the conditions of the work lead to variations in the assay itself, they must do the same for the proofs, and it is quite possible for the proofs to be very misleading. As a matter of fact, the base-metal proof question is an exceedingly troublesome one to deal with and requires the exercise of much thought and caution. Substantially the same proof may lead to widely differing corrections when the work is performed under supposedly similar conditions in the same laboratory. Under differing conditions in the same laboratory, and still more so under differing conditions of different laboratories, the proofs may give corrections differing astonishingly.

Quadruple base-metal assays were made with two sets of samples from two high-grade bullions. Eact set of four assays was run by itself with a proof between each pair of assays. The arrangement of figures in the table represents the arrangement of the cupels in the furnace, the top row representing the front row of cupels in each set. The fineness figures represent the combined gold and silver fineness shown after correcting the button weights by the proof figures in the middle.

ASSAYS WITH MIDDLE PROOFS, IN DOUBLE ROWS

1st samples		1st Bullion	2nd samples		
Gold and Silver Fineness	Proof	Gold and Silver Fineness	Gold and Silver Fineness	Proof	Gold and Silver Fineness
912.3	2.5—	912.8	910.4	0.2+	909.3
909.7	1.9—	911.3	910.2	0.4—	910.3
909.1	2.3—	908.3	907.5	0.4+	907.1
909.7	2.8—	909.8	908.6	0.0	908.3
909.9	2.6—	911.1	911.8	0.9+	911.5
910.5	3.3—	912.3	911.5	0.4+	911.5
907.6	2.4—	913.5	907.7	0.9+	909.0
909.3	2.5—	909.8	905.9	1.3+	905.4
		2nd Bullion			
953.3	1.69—	957.5	964.0	0.5+	952.2
953.2	2.30—	953.0	952.6	0.2—	952.9
954.0	1.37—	953.9	960.8	0.1+	952.6
954.2	2.25—	954.2	958.8	0.4—	959.2
957.7	1.04—	952.2	947.2	3.9+	953.6
955.3	1.75—	953.6	958.0	0.4—	952.2
958.2	1.19—	957.6	957.7	1.8+	957.2
956.6	2.15—	956.3	947.8	2.1+	953.0

COMPOSITION OF BULLIONS AND PROOFS

	Bullions		Proofs	
	No. 1	No. 2	No. 1	No. 2
Gold	713.75	758	714	760
Silver	198.	196	200	200
Base	88.25	46	Copper	30

These assays were all made in one laboratory by one assayer. The first samples were run at one time and the second at another. A part of the differences shown are undoubtedly due to differences in samples.

This table is worthy of most careful study. It discloses both the remarkable agreement and the utter unreliability of results at times yielded by this method of assay.

The mass of data presented in this paper warrants the following conclusions regarding the cupellation for base metal: There are two chief sources of operative error in this determination, the absorption of gold and silver by the cupel and the retention of base metal by the precious-metal button. At present we do not have the means of controlling either of these with any certainty, or of readily ascertaining their extent in commercial work. These errors may balance each other, but they often fail to do so. A low cupel absorption may be accompanied by either a high- or a low-button retention, or a high cupel absorption by either kind of button retention, and the relations may be reversed in the duplicates. A third defect arises from the fact that the proofs are subject to the same uncontrollable errors as the assays and the proof corrections may be fallacious.

Notwithstanding these defects, which render the method unsatisfactory, the simplicity and ease of execution of the cupellation method commend its use and undoubtedly it will be extensively employed for many years to come. It is also evident that the defects are inherent and that there is no apparent way of overcoming them in the present state of our knowledge. It therefore becomes necessary to seek for a better method, and preferably a direct determination of the silver.

The need for a better method leads to an extensive investigation of titrating with sulphocyanate. In a vast majority of cases the assay sample was alloyed with cadmium, in order to get the silver into solution in nitric acid, but in a few cases, sufficiently low in gold, the silver was dissolved directly. Duplicate samples of 12 bullions were prepared and 10 determinations were made, in four laboratories, by both cupellation and titration, making 40 determinations of silver on each bullion. All the results reported are tabulated in the paper. With each method certain results are evidently vitiated by accidents. Rejecting these we have the following differences between the highest and lowest finenesses, or ranges in the determinations:

DETERMINATIONS BY SULPHOCYANATE METHOD

No.	Cupel	S C	No.	Cupel	S C
1	8.25	24.00	7	5.50	8.75
2	7.50	7.50	8	15.50	9.00
3	6.75	16.00	9	13.00	12.00
4	4.25	6.75	10	10.00	10.00
5	7.00	10.00	11	9.00	8.00
6	4.00	10.00	12	10.75	9.00

The determination of silver in solution by titration with a solution of sulphocyanate was described by Volhard, in *Journ. für pract. Chem.,* in 1874, and is generally spoken of as the "Volhard method," but priority has been claimed for Charpentier, based upon publications in *Compt. rend.,* in 1871, and *Bull.* Soc. Ing. Civ. de France, in 1870.

In general, the method consists in adding a liberal amount of a ferric salt to the silver solution and then adding from a burette a solution of a sulphocyanate of a convenient strength, finishing drop by drop, until the characteristic red color of the ferric salt with sulphocyanate appears. More or less elaborate descriptions of it will be found in various textbooks.

When working upon high-grade silver, 992 fine or over, this method probably yields fully as accurate results as the Gay-Lussac method, titration with salt solution. No special apparatus is necessary and when only a few determinations are required, it is more rapid than the Gay-Lussac method. The chief advantages of the Gay-Lussac method is its ability to turn out, with proper equipment, a larger volume of work in a day's time.

When, however, the method is applied to miscellaneous materials, some objections appear. Mercury and palladium interfere. Moderate amounts of copper and platinum are not objected to. It is often said that 70% of copper may be present, but this is certainly a mistake. Nickel and cobalt obscure the end color. It has been suggested when Ni and Co are present to add excess of sulphocyanate and titrate back with silver. Chloride of silver must be absent, since it gradually reacts with sulphocyanate in solution. Lower oxides of nitrogen must be absent. Ferrous iron in presence of nitric acid must not be used as the indicator, since this would mean lower oxides of nitrogen. It should be noted that ferric sulphate as indicator may cause precipitation of lead sulphate when the bullion contains lead. It has been recommended to use two solutions, a standard and tenth standard.

In dissolving bullion carrying tin in nitric acid, purple of Cassius is almost always formed and this interferes most seriously in determining the sulphocyanate end point.

When the investigation was inaugurated, it developed that one of the small offices was already in the habit of using sulphocyanate titration on some deposits, and the following table shows their results on 15 bullions of widely varying composition arranged by progressively increasing silver fineness:

SULPHOCYANATE ON DIFFERENT BULLIONS

	Silver		Gold		Silver		Gold
	Cupel	Sulpho-cyanate			Cupel	Sulpho-cyanate	
No. 1	15	14.2	897.5	No. 9	275.0	276.8	652.75
	13.5	15.2			276.5	275.8	
No. 2	91	91.2	897.25	No. 10	319.25	314.3	608
	91	91.2			319.25	315.3	
No. 3	120.5	112.5	194	No. 11	338.0	338.6	436.75
	119.25	113.5			338.5	337.7	
No. 4	116.75	118.6	694.5	No. 12	402.75	401.5	594.5
	117.25	117.6			402.75	400.5	
No. 5	161.5	148	559.5	No. 13	434.0	438	548.75
	161.5	147			434.25	436	
No. 6	190.5	189.6	719	No. 14	440.25	434	537.75
	193.0	189.6			440.75	436	
No. 7	246	241.3	626.75	No. 15	440.5	446.1	549.5
	245	242.3			440.5	445.1	
No. 8	261.25	260.5	720.5				
	261.25	261.6					

Nos. 1 and 4 were cyanide bars, No. 5 was a jewelry scrap bar and No. 3 carried lead as the main base metal. The original office numbers on these bars were between 85 and 115, mass-melts 3, 4, 5 and 6, and chips bar No. 4.

At the redeposit office, five of these bars were also examined by the sulphocyanate method, being original bar No. 95 and mass melts 3, 4, 5 and 6.

RE-EXAMINATION BY SULPHOCYANATE METHOD

	1st test	2nd test	3rd test	4th test
No. 95	12.1	13.2	12.2	12.2
	10.1		13.2	13.2
Mass 3	271.9	270.2	272.8	270.8
	271.9	269.2		271.8
Mass 4	235.5	232.6	231.0	238.2
		234.7		239.2
Mass 5	186.5	181.8	187.3	186.3
	186.0	187.0	186.3	184.2
Mass 6	256.7	258.0	258.5	255.5
		258.0	258.5	255.5

Different samples of a bullion were submitted to three laboratories and assayed in duplicate by both methods. Ten of the 12 results fell between 441 and 444 fine in silver, showing a most remarkable agreement. Unfortunately, however, the other two results were much lower, as follows:

	Cupel	Sulphocyanate
First laboratory	443.0	434.0
	444.0	435.0
Second laboratory	444.0	441.9
	441.0	441.9
Third laboratory	441.0	444.0
	442.0	443.0
Gold	263.25	

Many more comparisons between the two methods and also with salt titration are given.

Careful consideration of these comparisons shows that the sulphocyanate method is capable of yielding satisfactory results in many instances, but the widely varying results often shown suggest the desirability of explicit instructions for carrying on the method and especially of pointing out probable and possible sources of error in the manipulations. Therefore, each assayer, whose work was used in this paper, was asked to write a history of his experience with the method. Also during the course of the tests various observations have been reported from time to time regarding the operation of the method. A study of this data has brought out the following points now discussed.

Various assayers prefer to make the cadmium alloy in a small porcelain crucible or annealing cup over a Bunsen burner or small blast lamp. This allows the direct transfer of the weighed sample to the crucible or cup before heating and the omission of the lead-foil container for the sample if desired. Dusty samples, however, should be inclosed in lead foil. The alloying operation is then easily observed and is under better control. Where much work is to be done, a copper stand to hold several assays may be made and this may be warmed up on the lip of the muffle or even inside the muffle after it has cooled down from other work, before heating over the lamp. Much less cyanide is required than in alloying in a scorifier. One assayer uses only three grams of cadmium. This, however, raises the question of the amount of silver retained by the residual gold. This point calls for further investigation. Personally I am also convinced that the very foundation of the work, the question of the formation of a proper alloy with the cadmium, requires investigation.

Much serious objection has been raised against alloying the samples with cadmium in a scorifier in the muffle, liability to crack after short use, liability of particles of sample to escape alloying with the cadmium, difficulty of observing the process, liability of overheating with sudden evolution of gas, particularly in adding Cd, which may project small particles of the sample out of the fusion, especially in the early stages of the operation, liability of small beads becoming entangled in the cyanide, particularly on pouring, are urged against this operation. Its chief advantage, in allowing the re-use of the cyanide, is greatly reduced by the fact that a much smaller amount of cyanide will answer in other containers.

There is very general objection to pouring the fusion, and it is preferred to cool the fusion in the crucible or cup, and to run water, warm if possible, directly into the cool crucible or cup to dissolve the cyanide. Where much work is done, an arrangement of small faucets allows the solution of the cyanide from several fusions at one time. A wire-gauze frame, with gauze cover, to hold several crucibles and a suitable rope sprinkler, make a very convenient dissolving arrangement.

Two assayers assert postively that the disappearance of fumes does not give sufficient heating of the solution, but that the solution must be vigorously boiled after that. Care must, however, be exercised to avoid mechanical loss of solution in this boiling. It is, therefore, better to dissolve the alloy in a conical flask rather than in a regular silver bottle. The titrating must be done absolutely cold, and all the conditions as to titrating must be kept as uniform as possible. When the bullion contains only a little silver, some operators prefer to add a known amount of silver to the solution before titrating.

When titrating a solution of pure silver, as in standardizing the solution, the end point may be sufficiently sharp, but, as it so often happens with volumetric methods in general when applied to miscellaneous materials, so this method presents its most serious difficulty in determining the end point in practical work. Also, as usual, the personal equation of the operator exerts its greatest influence at this point in the method. While it helps the work along to know approximately the amount of silver present, the careful operator is not obliged to make a preliminary assay for this purpose.

One bullion, No. 1 in the first comparison, yielded two groups of closely agreeing results and was exhaustively investigated with the result of showing that this bullion is quite unsuited to either volumetric method.

An extensive investigation on synthetic bullions and mixtures showed that if accurate results are desired, proofs must be run with the assays. Proofs will not only correct for the composition of the metal, but also for the visual variation of the operator. Of course, in miscellaneous work, bullions may be grouped and a generalized proof used for several titrations, just the same as such a general proof is often used in cupellation work.

While in the vast majority of cases, cupellation yields fairly concordant results, yet the determination of silver by this method in different laboratories often shows a difference of five in the fineness reported. Occasionally much larger differences are shown. In the comparisons, differences of five fine between individual determinations in the group are common. Even duplicate assays often show a difference of five fine.

While in the cadmium-sulphocyanate determinations wide differences often appear, yet in many cases the results agree among themselves and are often fully as concordant as the corresponding cupel results. Many of the differences are undoubtedly due to lack of familiarity by the operators with the method. The method has not been extensively employed and is comparatively new, when considered in connection with the many years of wide application of the cupellation method. With more extended and extensive use, much better agreement in the results could be expected. On the whole, therefore, this paper shows that the sulphocyanate method compares favorably with cupellation and stands a good chance of supplanting it where accuracy is desired.

Crude Oil Fuel—The Black Mountain Mining Co. with a power house on the railroad at Magdalena, Sonora, substituted Texas crude oil for coal with the following results, according to Percy E. Barbour: Oil cost 75c. plus $1.50 freight, making a total of $2.25 at the plant. Three barrels were used in place of one ton of coal which cost $7.15 laid down. Thus a saving of 40c. per ton of coal was made on the face and a further saving of waste and labor brought the total saving as figured by the management up to $1.50 per ton of coal in favor of oil fuel.

Design of Angle-Sheave Frames--I

By Floyd L. Burr*

SYNOPSIS—Treatise covering the entire subject of angle-sheave frame design. Nature of problem; unknown quantities which must be determined in designing; formulas derived by spherical and plane trigonometry; form sheet for computations. Graphical method for solving problem illustrated by examples. Four types of structure recognizable. Methods of erection of the several types.

The angle-sheave frame, according to my conception, is a structure designed to support a sheave wheel whose function is to turn a hoisting rope through an angle, thus changing its direction. Two portions of the rope will be considered, the entering portion and the emerging portion; and these portions may be considered and spoken of as two ropes. The plane of the two ropes may be a vertical plane, and thus all headframes would strictly be classed as angle-sheave frames.

These cases where both ropes are in the same vertical plane do not involve any difficulty mathematically, but the general case in which the rope changes direction both vertically and horizontally may be somewhat perplexing.

General Consideration of the Problem and Calculations

Of course, the general problem is to establish a sheave wheel of the desired size in such a position and at such inclination as to contain in its center plane the two ropes in their desired position and to allow the ropes to lie in the grooved rim of the wheel during their change in direction.

Generally the fixed conditions will involve a distant point from which the rope emerges, such as the center of the face of the hoisting drum or the rim of some other angle sheave, and a second distant point to which the rope is to travel, such as a head sheave or another angle sheave. Often there is also fixed the point in space at which the rope is to be changed in direction; if conditions do not rigidly fix this point, we must fix it arbitrarily. This last mentioned point will be called the "intersection point"; it is the point at which the ropes would intersect if they changed direction at the vertex of an angle instead of by following the groove of the wheel.

Knowing the relative positions of these three points in space or of their visibly marked positions on the ground, we may determine by any convenient form of survey or computation the horizontal angle between the ropes and the vertical angle of each rope.

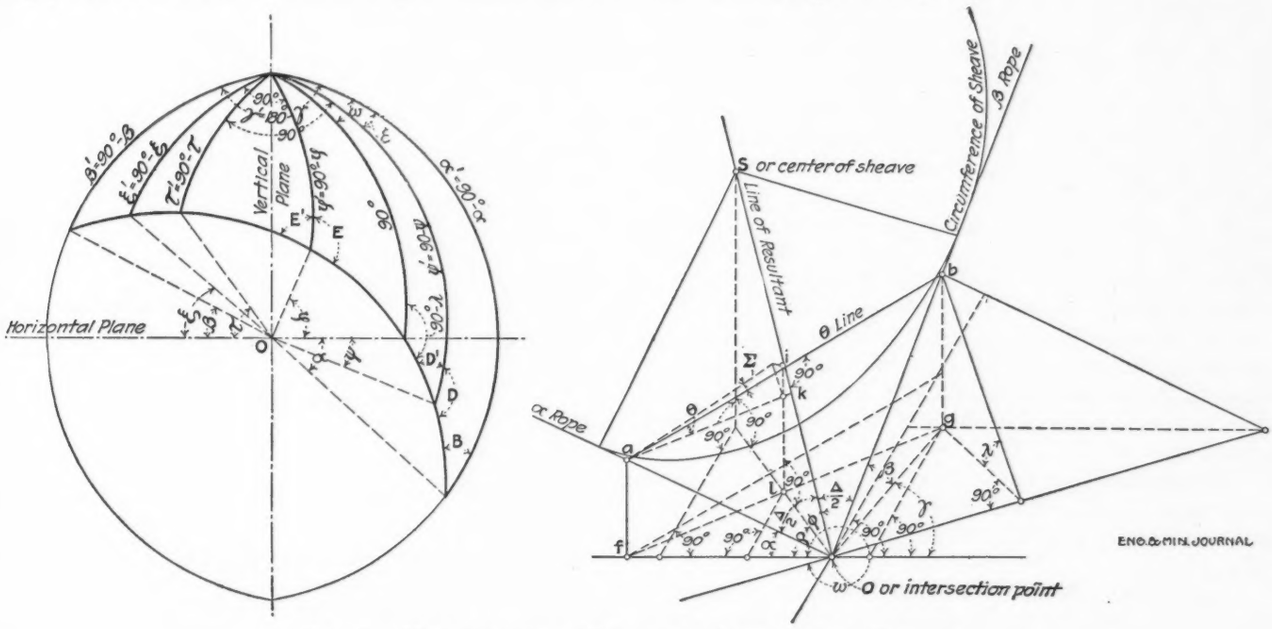

Fig. 1. Mathematical Relations Involved in Problem

Exhibited by plane trigonometry. Exhibited by spherical trigonometry.

Designations Used

We will designate one of these vertical angles α and the other β, and we will speak of the corresponding ropes as the "alpha-rope" and "beta-rope" and of vertical planes containing them as the "alpha-plane" and "beta-plane." Angles below the horizontal will be indicated as negative, the vertex of the angle being taken at the intersection point. The rope to be designated as the alpha-rope shall be so chosen that the horizontal angle of the beta-rope, measured from it in clockwise direction, shall be less than 180°. The supplement of this horizontal angle shall be designated γ. Thus we will have given the known angular quantities α, β and γ. Besides these angles the radius of the sheave, known as R, will be fixed or chosen. It should be noted that we may have both ropes below horizontal, or both above, or either one above while the other is below.

The unknown angle in space between the ropes, in the

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plane of the ropes—that is, the alpha-beta plane—shall be designated Δ. Neglecting the effect of friction, the line of resultant stress produced by the tension in the ropes will be the line which bisects Δ, or, in other words, the line joining the intersection point and the center of the sheave. We will call this "the line of the resultant." Its vertical angle we will designate as ϕ and its horizontal angle from the alpha-rope as ρ. We will designate as the "theta-line" a line in the alpha-beta plane normal to the line of the resultant. Its vertical angle shall be called θ and the vertical plane containing it the "theta-plane." In an inclined plane containing the theta-line and normal to the line of the resultant, the angle between the theta-line and the line along which this plane intersects a horizontal plane shall be designated Σ. The vertical angle of the line of intersection of the rope plane and a vertical plane normal to the vertical plane of the line of the resultant is ξ. The designation of the horizontal angle between the alpha-rope and the line of intersection of the plane of the ropes with the horizontal plane through the intersection point shall be ω. The angle of inclination of the alpha-beta plane shall be called λ. The vertical angle of the line of intersection of any vertical plane at any horizontal angle ε from the vertical plane of the alpha-rope is ψ. The vertical angle of the line of intersection with the alpha-beta plane of a vertical plane at right angles to the psi-plane is τ.

The inclined distance from the intersection point to the center of the sheave shall be called V, the horizontal projection of it W; the horizontal distance of the sheave center from the intersection point measured normal to the alpha-plane shall be called Z; the height of the center of the sheave above or below the intersection point shall be Y; the distance of the center of the sheave from the intersection point measured parallel to the alpha-plane shall be X.

To summarize, then, the known quantities are α, β, γ, ε and R, while the unknown ones are Δ, ϕ, λ, θ, Σ, ξ, ω, ρ, ψ, τ, V, W, X, Y and Z. The relations are exhibited in Fig. 1.

Depending upon the type of structure to be built and the method of laying out the construction, various groups of these angles will be used; ϕ-ρ-θ, ϕ-ρ-ξ, ϕ-ρ-Σ, and ψ-ε-τ are combinations most generally needed. The quantities, V, W, X, Y and Z are often useful and occasionally λ and ω may come into use. In many cases it would be wise to compute all the quantities in order to check as much as possible the correctness and accuracy of the work of computation and of laying out in the structure.

Formulas

In Table I are given formulas for the determination of all the unknown quantities. Two independent formulas are given for the determination of each of the quantities Δ, ϕ, ρ, θ, λ and ω, to enable one to check the determination of these fundamental values. Some of the formulas are based upon plane trigonometry and others on spherical trigonometry.

In the general use of these formulas, account must be taken of the algebraic signs of the functions of the angles and constant vigilance is needed in the lookout for negative signs. As an aid toward avoidance of error, and to facilitate computation and make it less fatiguing, it is found desirable before starting to use the formulas to fill out a list of all natural functions and logarithmic functions and simple combinations which will be required, and to include in this the algebraic signs of the quantities. With this preliminary work done, the remaining combinations are not at all tedious. The "form sheet" shown filled in in Tables II and III has been found to be most convenient. It gives the known quantities, the algebraic signs, the natural and logarithmic functions of known quantities together with simple combinations, the logarithmic functions of unknown quantities to be gradually derived and filled in, and a list of results.

TABLE I. FORMULAS FOR VARIOUS UNKNOWN QUANTITIES USED IN ANGLE-SHEAVE CALCULATIONS

Given quantities α, β, γ, and R and sometimes ϵ. To find the values of the useful quantities φ, ρ, θ, Σ, ξ, ω, λ, V, W, X, Y, Z, and sometimes ψ and τ and also of the incidental quantities α', β', γ', Δ, $\frac{\Delta}{2}$, B, φ', D, D', E, E', ξ, and ψ'.

Definition Formulas

$\alpha' = 90° - \alpha$ $\quad \varphi' = 90° - \varphi$

$\beta' = 90° - \beta$ $\quad \psi' = 90° - \psi$

$\gamma' = 180° - \gamma$ $\quad \xi' = 90° - \xi$

$D' = 180° - D$

$E' = 180° - E$

$\tau' = 90° - \tau$

Principal Formulas

$$\cos\Delta = \cos\beta' \cdot \cos\alpha' + \sin\beta' \cdot \sin\alpha' \times \cos\gamma'$$

$$\sin\frac{\Delta}{2} = \frac{\sqrt{2}}{2} \times \sqrt{1 - \sin\alpha \cdot \sin\beta + \cos\alpha \cdot \cos\beta \cdot \cos\gamma}$$

$$\sin B = \frac{\sin\beta' \cdot \sin\gamma'}{\sin\Delta}$$

$$\cos\varphi' = \cos\alpha' \cdot \cos\frac{\Delta}{2} + \sin\alpha' \cdot \sin\frac{\Delta}{2} \cdot \cos B$$

$$\sin\varphi = \frac{\sin\beta + \sin\alpha}{2\cos\frac{\Delta}{2}}$$

$$\sin\rho = \frac{\sin\frac{\Delta}{2} \cdot \sin B}{\sin\varphi'}$$

$$\tan\rho = \frac{\cos\beta \cdot \sin\gamma}{\cos\alpha - \cos\beta \cdot \cos\gamma}$$

$$\sin\rho = \frac{\sin\gamma \cdot \cos\beta \cdot \tan\varphi}{\sin\beta + \sin\alpha}$$

$$\sin\theta = \frac{\sin\beta - \sin\alpha}{2\sin\frac{\Delta}{2}}$$

$$\cos\theta = \frac{\sqrt{\cos^2\alpha + \cos^2\beta + 2\cos\alpha \cdot \cos\beta \cdot \cos\gamma}}{2\sin\frac{\Delta}{2}}$$

$$\sin\Sigma = \frac{\sin\theta}{\cos\varphi}$$

$$\sin E = \frac{\sin\alpha' \cdot \sin B}{\sin\varphi'}$$

$$\tan\xi' = \sin\varphi' \cdot \tan E'$$

$$\tan\lambda = \frac{\sqrt{\tan^2\alpha + \tan^2\beta + 2\cos\gamma \cdot \tan\alpha \cdot \tan\beta}}{\sin\gamma}$$

$$\sin\lambda' = \sin B \cdot \sin\alpha'$$

$$\sin\omega = \frac{-\tan\alpha}{\tan\lambda}$$

$$\tan\omega = -(\cos\alpha' \tan B)$$

$$\cos D = -\cos B \cdot \cos\epsilon + \sin B \cdot \sin\epsilon \cdot \cos\alpha'$$

$$\sin\psi' = \frac{\sin B \cdot \sin\alpha'}{\sin D}$$

$$\tan\tau' = \sin\psi' \cdot \tan D'$$

$$V = \frac{R}{\sin\frac{\Delta}{2}}$$

$$W = V \cdot \cos\varphi$$

$$X = \frac{R}{\sin\Delta}(\cos\alpha - \cos\beta \cdot \cos\gamma)$$

$$X = W \cdot \cos\rho$$

$$Y = \frac{R}{\sin\Delta}(\sin\beta + \sin\alpha)$$

$$Y = V \cdot \sin\varphi$$

$$Z = \frac{R}{\sin\Delta} \cdot (\cos\beta \cdot \sin\gamma)$$

$$Z = W \cdot \sin\rho$$

Table of Algebraic Signs

		Sine	Cosine	Tangent
1st quadrant	0° to 90°	+	+	+
2nd quadrant	90° 180°	+	−	−
3rd quadrant	180° 270°	−	−	+
4th quadrant	270° 360° or 0° −90°	−	+	−

Solution by Graphical Method

Another method for determining the needed elements of the angle-sheave problem is the graphical. This method may be a little faster than the analytical and does away with the necessity for alertness in looking for negative signs, but it has its own disadvantages. It may be used as the principal method or as a check method. Two drawings for the problems are reproduced herewith, Figs. 2 and 3, to illustrate the method.

In diagram No. 1, Fig. 2, we have both ropes above the horizontal plane; let α be 25° and β 40°. Let γ equal 70° and let the sheave wheel be 10 ft. in diameter. It is required to find the values of the unknown quantities.

In the first diagram, draw a horizontal line, and from a point o draw lines representing the alpha-rope and the beta-rope at angles of 25° and 40° above the hori-

zontal. On these lines lay off a convenient unit distance *oa* equals *ob*, say 10 in., and from the points *a* and *b* draw perpendiculars to the horizontal line intersecting it at *c* and *d*. The lines *oc* and *od* are then the horizontal projections of the unit distances.

Now in the second diagram, draw lines *o'f* and *o'g* equal to *od* and *oc* at angle γ, and complete the triangle by drawing the third side *fg*. This then is a diagram of horizontal projections.

TABLE II. FORM SHEET FILLED OUT IN COMPUTATIONS OF ILLUSTRATIVE PROBLEM NO. 1

$\alpha = +25°$ $\alpha' = 65°$
$\beta = +40°$ $\beta' = 50°$
$\gamma = 70°$ $\gamma' = 110°$
$R = 5$ ft.
$\epsilon = 35°$

Logarithms

$\sin \alpha$	$= 9.625\ 9483+$
$\cos \alpha$	$= 9.957\ 2757+$
$\tan \alpha$	$= 9.668\ 6725+$
$\sin \beta$	$= 9.808\ 0675+$
$\cos \beta$	$= 9.884\ 2540+$
$\tan \beta$	$= 9.923\ 8135+$
$\sin \gamma$	$= 9.972\ 9858+$
$\cos \gamma$	$= 9.534\ 0517+$
$\sin \epsilon$	$= 9.758\ 5913+$
$\cos \epsilon$	$= 9.913\ 3645+$
$\sin \alpha'$	$= 9.957\ 2757+$
$\cos \alpha'$	$= 9.625\ 9483+$
$\sin \beta'$	$= 9.884\ 2540+$
$\cos \beta'$	$= 9.808\ 0675+$
$\sin \gamma'$	$= 9.972\ 9858+$
$\cos \gamma'$	$= 9.534\ 0517-$
$\sin \beta + \sin \alpha$	$= 0.027\ 5152+$
$\sin \beta - \sin \alpha$	$= 9.342\ 7581+$
$\cos \beta \cdot \cos \gamma$	$= 9.418\ 3057+$
$\cos \beta \cdot \sin \gamma$	$= 9.857\ 2398+$
$\cos \alpha - \cos \beta \cdot \cos \gamma$	$= 9.809\ 0914+$
R	$= 0.698\ 9700+$
$\frac{\sqrt{2}}{2}$	$= 9.849\ 4850+$
$\sin \Delta$	$= 9.999\ 7459+$
$\frac{R}{\sin \Delta}$	$= 0.699\ 2241+$
$\sin \frac{\Delta}{2}$	$= 9.841\ 9289+$
$\cos \frac{\Delta}{2}$	$= 9.856\ 7876+$
$2 \sin \frac{\Delta}{2}$	$= 0.142\ 9589+$
$2 \cos \frac{\Delta}{2}$	$= 0.157\ 8176+$
$\frac{R}{\sin \frac{\Delta}{2}}$	$= 0.857\ 0411+$
$\sin B$	$= 9.857\ 4989+$
$\cos B$	$= 9.841\ 1688+$
$\tan B$	$= 0.016\ 3258+$
$\sin \varphi'$	$= 9.827\ 1957+$
$\cos \varphi'$	$= 9.869\ 6981+$
$\sin \varphi$	$= 9.869\ 6976+$
$\cos \varphi$	$= 9.827\ 1957+$
$\tan \varphi$	$= 0.042\ 5022+$
$\sin \rho$	$= 9.872\ 2271+$
$\cos \rho$	$= 9.824\ 0802+$
$\tan E'$	$= 0.614\ 9109-$
$\tan \lambda$	$= 0.064\ 6382+$
$\sin D$	$= 9.963\ 4390+$
$\tan D'$	$= 0.368\ 3312+$
$\sin \psi'$	$= 9.851\ 3306+$
V	$= 0.857\ 0411+$
W	$= 0.684\ 2368+$

Natural Functions

$\sin \alpha$	$= 0.422618+$
$\cos \alpha$	$= 0.906308+$
$\cos^2 \alpha$	$= 0.821394+$
$\tan^2 \alpha$	$= 0.217443+$
$\sin \beta$	$= 0.642788+$
$\cos^2 \beta$	$= 0.586824+$
$\tan^2 \beta$	$= 0.704088+$
$\sin \alpha \cdot \sin \beta$	$= 0.271654+$
$\cos \alpha \cdot \cos \beta \cdot \cos \gamma$	$= 0.237455+$
$2 \cos \alpha \cdot \cos \beta \cdot \cos \gamma$	$= 0.474910+$
$2 \cos \gamma \cdot \tan \alpha \tan \beta$	$= 0.267650+$
$\cos \beta' \cdot \cos \alpha'$	$= 0.271654+$
$\sin \beta' \cdot \sin \alpha' \cdot \cos \gamma'$	$= 0.237455-$
$\cos \alpha' \cdot \cos \frac{\Delta}{2}$	$= 0.303904+$
$\sin \alpha' \cdot \sin \frac{\Delta}{2} \cdot \cos B$	$= 0.436891+$
$-\cos B \cdot \cos \epsilon$	$= 0.568242-$
$\sin B \cdot \sin \epsilon \cdot \cos \alpha'$	$= 0.174596+$

Results

Δ	$= 88° 02' 24''$
$\frac{\Delta}{2}$	$= 44° 01' 12''$
B	$= 46° 04' 36''$
φ'	$= 42° 12' 03''$
D	$= 113° 10' 54''$
D'	$= 66° 49' 06''$
E	$= 103° 38' 27''$
E'	$= 76° 21' 33''$
ξ'	$= 70° 08' 03''$
ψ'	$= 45° 14' 40''$
τ'	$= 58° 54' 32''$
ϕ	$= 47° 47' 57''$
ρ	$= 48° 10' 10''$
θ	$= 9° 06' 54''$
Σ	$= 13° 38' 26''$
ξ	$= 19° 51' 57''$
ω	$= 336° 18' 28''$
λ	$= 49° 15'$
ψ	$= 44° 45' 20''$
τ	$= 31° 05' 28''$
V	$= 7.195$
W	$= 4.833$
X	$= 3.223$
Y	$= 5.330$
Z	$= 3.601$

In the first diagram, draw a horizontal line through *a*. From the intersection *e* lay off to the left the distance *eh* equal to *fg*. Draw a straight line through *h* and *b* and we have the theta-line and the angle θ.

From *h* and *b* draw arcs with unit distance as radii and establish point *o''* at the intersection. This determines Δ and the line of resultant may be drawn in, bisecting it. This last portion of the first diagram, of course, represents the alpha-beta plane.

From the center point *i* of the theta-line, draw a line *ij* perpendicular to the horizontal line *cd*; *ij* is the elevation of the point *i* of the line of resultant above the intersection point of the ropes *o*. Now on the second diagram lay off from *f* the distance *fl* equal to *hk* and draw in the horizontal projection of the line of resultant, determining ρ. Lay off from *j* in either direction *jm* equal to *o'l* and complete the triangle of reference, determining ϕ.

In the second diagram draw from the point *l* a line perpendicular to *o'l*, intersecting *o'f* at *n*. Then in the first diagram lay off to the left from *o* on *oc* a distance *ox* equal to *o'n*, and erect a perpendicular at *x*, intersecting *oa* at *y*. Draw a horizontal line through *y*, intersecting *ji* at *z*. Then lay off *zp* equal to *ln* and draw *pi*, completing the triangle of reference for ξ.

In that portion of the first diagram which represents the alpha-beta plane draw in a circle tangent to the two rope lines from center *s* to represent the sheave wheel. It may be drawn at any convenient scale, say ½ in. to the foot. *o''s* will then be the distance *V*. Lay off *mt* equal to *V* on the line *mi* and let fall a perpendicular line *tu* to the horizontal line. Then *tu* equals *Y* and *um* equals *W*. In the second diagram, lay off *o'v* equal to *um* on line *o'l* and draw a perpendicular *vw*, which equals *Z*, while *o'w* equals *X*.

TABLE III. FORM SHEET FILLED OUT FOR ILLUSTRATIVE PROBLEM NO. 2

$\alpha = -25°$ $\alpha' = 115°$
$\beta = +40°$ $\beta' = 50°$
$\gamma = 70°$ $\gamma' = 110°$
$R = 5$ ft.
$\epsilon = 35°$

Logarithms

$\sin \alpha$	$= 9.625\ 9483-$
$\cos \alpha$	$= 9.957\ 2757+$
$\tan \alpha$	$= 9.668\ 6725-$
$\sin \beta$	$= 9.808\ 0675+$
$\cos \beta$	$= 9.884\ 2540+$
$\tan \beta$	$= 9.923\ 8135+$
$\sin \gamma$	$= 9.972\ 9858+$
$\cos \gamma$	$= 9.534\ 0517+$
$\sin \epsilon$	$= 9.758\ 5913+$
$\cos \epsilon$	$= 9.913\ 3645+$
$\sin \alpha'$	$= 9.957\ 2757+$
$\cos \alpha'$	$= 9.625\ 9483-$
$\sin \beta'$	$= 9.884\ 2540+$
$\cos \beta'$	$= 9.808\ 0675+$
$\sin \gamma'$	$= 9.972\ 9858+$
$\cos \gamma'$	$= 9.534\ 0517-$
$\sin \beta + \sin \alpha$	$= 9.342\ 7581+$
$\sin \beta - \sin \alpha$	$= 9.027\ 5152+$
$\cos \beta \cdot \cos \gamma$	$= 9.418\ 3057+$
$\cos \beta \cdot \sin \gamma$	$= 9.857\ 2398+$
$\cos \alpha - \cos \beta \cdot \cos \gamma$	$= 9.809\ 0914+$
R	$= 0.698\ 9700+$
$\frac{\sqrt{2}}{2}$	$= 9.849\ 4850+$
$\sin \Delta$	$= 9.934\ 8531+$
$\frac{R}{\sin \Delta}$	$= 0.764\ 1169+$
$\sin \frac{\Delta}{2}$	$= 9.938\ 8453+$
$\cos \frac{\Delta}{2}$	$= 9.694\ 9779+$
$2 \sin \frac{\Delta}{2}$	$= 0.239\ 8753+$
$2 \cos \frac{\Delta}{2}$	$= 9.996\ 0079+$
$\frac{R}{\sin \frac{\Delta}{2}}$	$= 0.760\ 1247+$
$\sin B$	$= 9.922\ 3867+$
$\cos B$	$= 9.738\ 9390+$
$\tan B$	$= 0.183\ 4477+$
$\sin \varphi'$	$= 9.989\ 0051+$
$\cos \varphi'$	$= 9.346\ 7500+$
$\sin \varphi$	$= 9.346\ 7502+$
$\cos \varphi$	$= 9.989\ 0051+$
$\tan \varphi$	$= 9.357\ 7450+$
$\sin \rho$	$= 9.872\ 2269+$
$\cos \rho$	$= 9.824\ 0802+$
$\tan E'$	$= 0.092\ 0225-$
$\tan \lambda$	$= 9.934\ 7636+$
$\sin D$	$= 9.879\ 8964+$
$\tan D'$	$= 0.065\ 7866+$
$\sin \psi'$	$= 9.999\ 7660+$
V	$= 0.760\ 1247+$
W	$= 0.749\ 1298+$

Natural Functions

$\sin \alpha$	$= 0.422618-$
$\cos \alpha$	$= 0.906308+$
$\cos^2 \alpha$	$= 0.821394+$
$\tan^2 \alpha$	$= 0.217443+$
$\sin \beta$	$= 0.642788+$
$\cos^2 \beta$	$= 0.586824+$
$\tan^2 \beta$	$= 0.704088+$
$\sin \alpha \sin \beta$	$= 0.271654-$
$\cos \alpha \cdot \cos \beta \cdot \cos \gamma$	$= 0.237455+$
$2 \cos \alpha \cdot \cos \beta \cdot \cos \gamma$	$= 0.474910+$
$2 \cos \gamma \cdot \tan \alpha \cdot \tan \beta$	$= 0.267650-$
$\cos \beta' \cdot \cos \alpha'$	$= 0.271654-$
$\sin \beta' \sin \alpha' \cos \gamma'$	$= 0.237455-$
$\cos \alpha' \cos \frac{\Delta}{2}$	$= 0.209376-$
$\sin \alpha' \cdot \sin \frac{\Delta}{2} \cdot \cos B$	$= 0.431579+$
$-\cos B \cdot \cos \epsilon$	$= 0.449059-$
$\sin B \sin \epsilon \cdot \cos \alpha'$	$= 0.202734-$

Results

Δ	$= 120° 36' 16''$
$\frac{\Delta}{2}$	$= 60° 18' 08''$
B	$= 56° 45' 23''$
φ'	$= 77° 09' 42''$
D	$= 130° 40' 37''$
D'	$= 49° 19' 23''$
E	$= 128° 58' 29''$
E'	$= 51° 01' 31''$
ξ'	$= 50° 18' 51''$
ψ'	$= 88° 07' 10''$
τ	$= 49° 18' 28''$
φ	$= 12° 50' 18''$
ρ	$= 48° 10' 10''$
θ	$= 37° 49' 30''$
Σ	$= 38° 58' 29''$
ξ	$= 39° 41' 09''$
ω	$= 32° 48' 44''$
λ	$= 40° 42' 46''$
ψ	$= 1° 52' 50''$
τ	$= 40° 41' 32''$
V	$= 5.756$
W	$= 5.612$
X	$= 3.743$
Y	$= 1.279$
Z	$= 4.182$

Following out a similar manner of reasoning and graphical representation, the other unknown quantities are readily determined.

When α and β are both negative—that is, when both ropes are below the horizontal—the graphical solution will be identical with the one described. When α is negative and β positive, the principle will be the same with a slight difference in arrangement of the lines. Diagrams 3, 4 and 5 of Fig. 3 work out the problem under these conditions. No further explanation will be required.

Tables II and III give the calculations necessary in solving these two problems by the analytical method.

These angle-sheave problems do not in most engineers' experience come frequently and hence do not become routine work. Consequently I do not consider great speed in solving to be essential, but it is obvious that the results must be correct and generally need at least a fair degree of accuracy.

The Types of Structure

In any angle-sheave frame whatever, the sheave wheel will be supported by a pair of members whose axes lie in planes parallel to the plane of the sheave, or, in other words, the alpha-beta plane. Generally also the plane containing these two axes will be at right angles to the plane of the sheave. These members will usually at their ends frame into main supports which are vertical, horizontal or at right angles to the sheave supports.

For the purpose of placing these members either in the drawings or, in some forms of construction, in the structure itself, it will be necessary to know the longitudinal and transverse inclinations of the members. This is the same as saying that we need the inclinations or vertical angles of two intersecting lines of the alpha-beta plane.

In the design of those types of structures where it is feasible, it will be found desirable to place these members approximately parallel or normal to the line of the resultant. For these cases the angles ϕ and θ, or ϕ and ξ, will give the inclinations required. Sometimes the angle Σ will be useful.

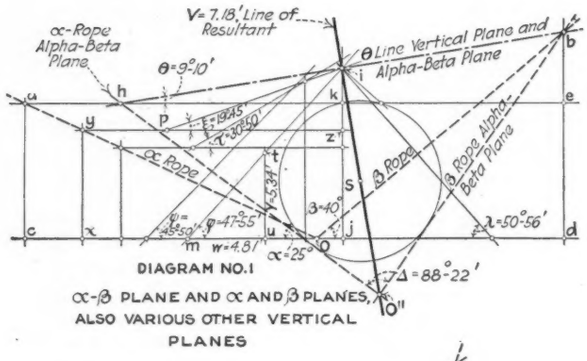
When the supporting members cannot be placed parallel or normal to the line of the resultant, it will be necessary to fix their horizontal direction expressed as angle ε and to compute or to determine graphically the longitudinal and transverse inclinations ψ and τ of the members for their specified directions. Their axes are, of course, also in planes parallel to the alpha-beta plane. Then in the design or erection of the structure, these angles ε, ψ and τ are used in the same way as ρ, ϕ and ξ.

I recognize four principal types of framework, briefly described as follows:

Type No. 1—When the line of the resultant is steep and either upward or downward, the principal part of the frame may take the form of a pair of members parallel to the resultant reaching upward into the air from a concrete or other base. The sheave is attached to these members and the stress, tension or compression depending upon the direction of the resultant is transmitted to the concrete base, which by virtue of its weight resists the lifting tendency or by its stiffness spreads the compression over a sufficient area of the soil beneath, while by end bearing and skin friction it resists the tendency to slide horizontally. The tension or compression members may be of steel or wood. A variation of this type would be a case in which these main members are attached to some other extensive structural frame beneath, through the medium of which the stress is transmitted to the earth.

Type No. 2—When the line of the resultant is comparatively flat, the frame may consist essentially of a pair of strut-beam members parallel to the resultant, framed between two piers or towers, one or both of which will tend to overturn in a longitudinal direction when the rope is stressed. The piers or towers may be of steel or wood or concrete or reinforced concrete, while the strut-beam may be of wood, steel or reinforced concrete. The towers or piers may, as a variation in design, get some of their stability from diagonal tension or compression braces reaching to the ground or to auxiliary piers or natural anchorages.

Type No. 3—The same sort of a structure as that mentioned for type 2 may be set with the supporting-beam members normal to the resultant. In this case the resultant load subjects the members to the bending stress only, and tends to overturn the towers in a transverse direction.



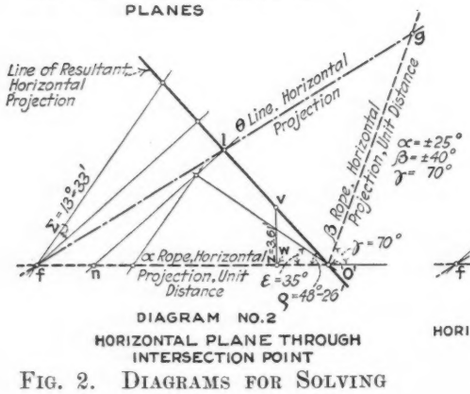
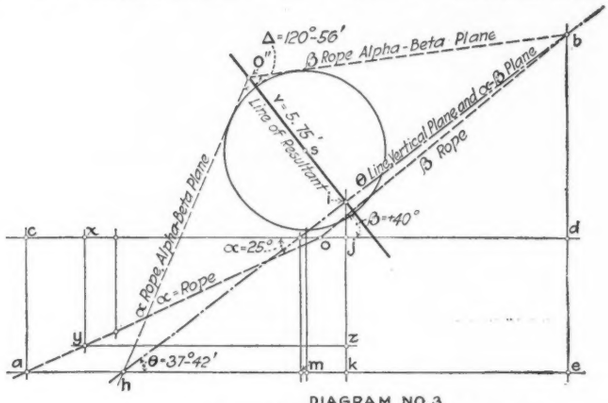
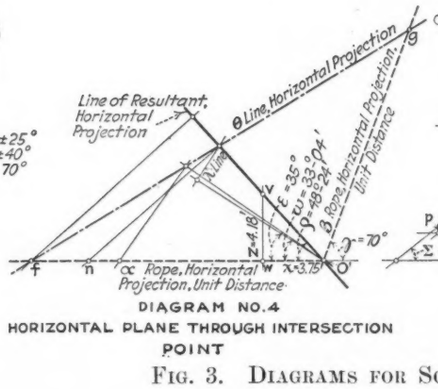


Fig. 2. Diagrams for Solving Problem 1




Line of Resultant, Horizontal Projection
θ Line, Horizontal Projection
β Rope, Horizontal Projection, Unit Distance
α Rope, Horizontal Projection, Unit Distance
DIAGRAM NO.4
HORIZONTAL PLANE THROUGH INTERSECTION POINT

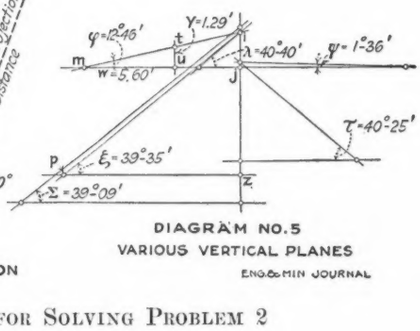


Fig. 3. Diagrams for Solving Problem 2

Type No. 4—When it is not convenient to set the supporting members either parallel or normal to the line of the resultant, these members may be set in a convenient direction and supported by two towers or piers. The stress effects are of course a combination of those in the preceding two types.

It should also be mentioned that in the last three types there may be only one heavy pier or tower from which beams may extend as cantilevers to support the sheave wheel. Of course, many variations are possible.

Fig. 4 shows sketches of these various types.

We are now concerned with the method of laying out or putting into position the supporting beams. The method will be different for different types.

Method of Erecting Type 1

Taking up the first type, we must first of all establish on the ground a point such as a stake, nail or other mark, which is vertically under the intersection point and at a known difference of elevation. At a convenient short distance from it there must be set similarly another point in the vertical plane of the resultant. These points are readily established, as we have had the intersection point fixed from the beginning, and to get the vertical plane of the resultant we have merely to set up the transit at the intersection point and turn off the angle ρ as a horizontal angle. Of course, the angle may be turned off without a transit if necessary. Now the frame will consist of two members braced together, of required length, and provided with necessary foot plates or anchorage details, and with necessary detail for support of the sheave bearings. On this frame, as it lies on the ground, we will mark the intersection point and also a point farther along on the center line at such a location that when the frame is in position this point will be vertically over the second point on the ground. A plumb-bob is suspended from each of the two points on the frame and the frame is tilted up by tackle and shifted and rolled until the following conditions obtain: Each plumb-bob is over its corresponding point on the ground; the intersection point is at proper elevation; the members stand at the longitudinal inclination of the angle ϕ, as determined by a good contact clinometer or by tangent measurements; the members stand at a transverse inclination of the angle θ, as determined by the clinometer on a thin-edged straight-edge laid across the faces of both members at right angles to their axes at any convenient longitudinal point.

In case the intersection point on the frame is inaccessible, a point at a known distance from it on the center line may be used instead. In case the plumb lines would not hang free from the points mentioned on the center line, points on an offset line may be used; of course, making corresponding offset corrections or changes in points on the ground.

It can be understood readily that this method is somewhat tedious, as it is strictly a case of successive approximations. The adjustment for one angle throws out the adjustment for the other. In order to avoid most of the use of the clinometer, a slightly different method was used on the last structure of this type which has been built by the Penn company. By this method, a plumb-line was suspended from a convenient point of determined location on top of the frame and a fixed point established at the bottom of the frame, so located by computation as to be vertically under the point of suspension when the members stand at the inclination angles ϕ and θ. By watching the plumb-line and the lower point, the members could thus be brought to proper inclination. The angles ϕ and θ could then be checked by the use of the clinometer.

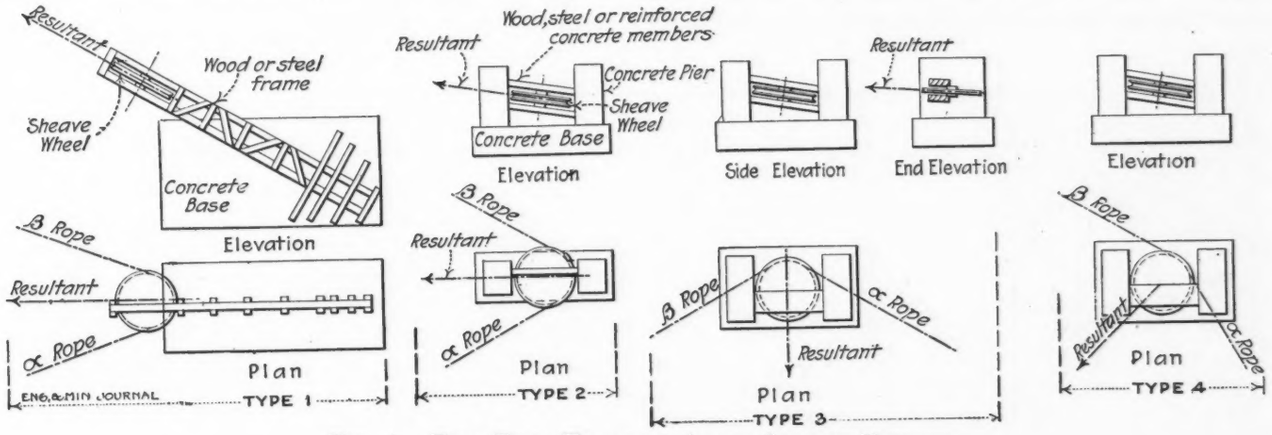


Fig. 4. The Four Types of Angle-Sheave Frames

Erecting Types 2, 3 and 4

In establishing the position of the members for the second type, if those members be of steel, wood or reinforced concrete, built into piers of concrete, the angles used will generally be ρ, ϕ and ξ. In all this work the linear quantities V, W and Y will generally be needed at some stage of the work.

The pier forms should first be erected, leaving the inside faces open. The steel or wood strut-beams should then be put in and tilted, rolled and lifted until they are at proper longitudinal and transverse inclinations as per ϕ and ξ or ϕ and θ. If these members are rather heavy it will be best to lay out supports for them beforehand by spiking across the open side s of the pier forms wooden pieces for them to rest upon. These pieces are to be placed at the inclination ξ. They must be set at proper elevation and a line connecting their centers must be inclined at the angle ϕ. Wooden straight-edges and a good contact clinometer will be useful in this work.

In case the strut-beams are to be of reinforced concrete their forms are to be treated precisely as if they were the members themselves.

If the strut-beam members are of steel, framed into steel towers or girders, the angles ρ, ϕ and θ or Σ or ξ will be

used in making up the detail drawings for the structural connections. The correct fabrication of the parts will leave nothing to lay out in the field except the center lines of the structure.

What has been said about type 2 will apply equally well to types 3 and 4, except that the angles will not be the same. In type 3, ϕ will be transverse inclination and ξ will be longitudinal. In type 4, ϵ will fix the center line, ψ will be longitudinal inclination and τ transverse inclination.

(To be continued)

Guggenheim Exploration Co.

The report of the Guggenheim Exploration Co. for the year ended Dec. 31, 1914, shows net income of $3,383,622, equal to 16.27% on the outstanding capital stock. The surplus on the above date amounted to $24,972,000, an increase of $160,660, as compared with the previous year.

At the end of the first quarter the dividend was increased from 12% to 14% per annum, which is the present rate. The statement of assets and liabilities as of Dec. 31 last shows:

Assets—	1914
Am. Smelters' Sec. Co. "A" (33,656 shares)	$3,029,040
*Utah Copper Co. (404,504 shares)	9,161,767
*Yukon Gold Co. (2,842,625 shares)	10,114,564
*Chino Copper Co. (97,750 shares)	2,534,803
*Am. Smelt. & Ref. Co. com. (69,500 shares)	4,767,265
*Ray Cons. Copper Co. (154,300 shares)	3,245,851
*Miscellaneous investments	56,439
*Alaska Yukon properties	1,047,262
Furniture, fixtures, etc.	1,630
Accounts collectible	1,406
Cash and demand loans	11,837,273
Total	$45,797,300
Liabilities—	
Capital stock outstanding	$20,793,300
Unpaid taxes (estimated)	32,000
Surplus	24,972,000
Total	$45,797,300

*Carried at cost.

The statement of assets shows that the company's stock holdings underwent no change during the year except in American Smelters' Securities Co. "A" stock, which was decreased by 344 shares. It has also disposed of a book value of $72,181 of its Alaska Yukon assets.

Taking Feb. 1 quotations of 90 for Smelters' preferred A; 53⅞ for Utah Copper, Yukon Gold at 2¾, Chino at 36, A. S. & R. common at 62⅜, Ray Con. at 17⅞ and the rest of the investments at book value, Guggenheim Exploration has a present value of $67.57 per share.

Sweden's Iron and Steel Trade and the War

SPECIAL CORRESPONDENCE

The war has had a paralyzing effect on Sweden's industry generally. Her stone export has practically ceased, and the recent German embargo on her timber export will seriously affect this important Baltic trade. In iron and steel the exports fell, in August, 1914, to 13,600 tons, as against 47,800 tons in the same month of 1913. With better shipping service during September and October there was some improvement, and the total export went up respectively to 32,400 and 33,200 tons, though during the corresponding months in 1913 the figures were 45,400 and 55,500 tons. The iron-ore export to the end of October was 1,472,000 tons less this year than for the same period of last year. There were 125 Lancashire furnaces operating during August and September, but at the end of October, there were only 110 working. Of the total of 24 bessemer converters, only 9 were in operation at the end of October, and of the 75 Martin furnaces only 49. The pig-iron output had, during the first 10 months of the year, been less by 56,000 tons as compared with the same period in 1913. The outlook as regards water-power supply, in connection with the iron works, during the winter, is particularly dark, and it is complained that decision on debatable questions of water rights has been hung up too long.

The iron mines in Kiruna are working five days in the week, and at Malmberget four days. The transport of ore to the Norwegian shipping port of Narvik has fallen since the war to about 50,000 tons monthly, as against a normal 200,000 tons.

The Grängesberg Bolaget has notified the Swedish State that it purposes shipping to the Rigsgraendsen Station from Kiruna, 3,950,000 tons of iron ore during 1916. The amount for 1915 will be 3,738,000 tons, and the total for 1914 was 3,700,000 tons. This will mean that practically the whole of the output will be shipped from Narvik.

Last November a giant blast was put in at the Sydvaranger iron mines, North Norway. The charge was 6000 kg. of dynamite. The shock for miles around is described as similar to that of a strong earthquake.

Articles Contraband of War

A proclamation revising the list of articles to be treated as contraband of war has been issued recently by the British government, all previous ones on the same subject having been withdrawn. The articles enumerated in Schedule I will in future be treated as absolute contraband, and the articles mentioned under Schedule II will be considered as conditional contraband, says the *Iron Trade Review*.

We give only those articles of interest to the mining industry.

SCHEDULE I

Powder and explosives specially prepared for use in war. Ingredients of explosives, viz., nitric acid, sulphuric acid, glycerine, acetone, calcium acetate and all other metallic acetates, sulphur, potassium nitrate, the fractions of the distillation products of coal tar between benzol and cresol inclusive, aniline, methylaniline, dimethylaniline, ammonium perchlorate, sodium perchlorate, sodium chlorate, barium chlorate, ammonium nitrate, cyanamide, potassium chlorate, calcium nitrate, mercury.

Ferroalloys, including ferrotungsten, ferromolybdenum, ferromanganese, ferrovanadium, ferrochrome.

The following metals: Tungsten, molybdenum, vanadium, nickel, selenium, cobalt, pig iron, manganese.

The following ores: Wolframite, scheelite, molybdenite, manganese ore, nickel ore, chrome ore, hematite, zinc ore, lead ore, bauxite.

Aluminum, alumina and salts of aluminum. Antimony, together with the sulphides and oxides of antimony. Copper, unwrought and part wrought, and copper wire. Lead, pig, sheet or pipe. Iron pyrites. Mineral oils and motor spirit, except lubricating oils.

SCHEDULE II

Fuel, other than mineral oils. Lubricants.

Powder and explosives not specially prepared for use in war.

Details of Practical Mining

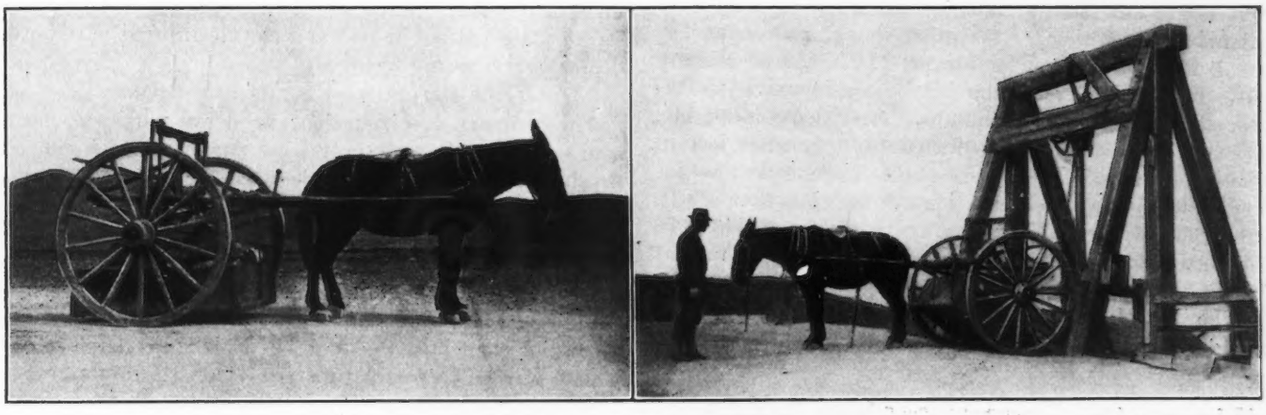
Cart for Rock Quarries

By George Benton Wilson*

In quarries, broken rock is usually transported by cars running on tracks and drawn by locomotives or mules. This method is not without its disadvantages, among which may be mentioned the following: The cars frequently become derailed, and time is consumed in taking up and relaying the tracks. Even in quarries where the tracks are carefully removed before blasting, much broken rail is to be seen on the dump. Shoveling into high cars is slow and inefficient, and it is difficult to devise trackage that will always distribute the cars close to the face. The shovelers are often idle while the trammers are replacing loaded cars with empty ones.

All of these objections have been overcome or minimized by the American Smelting & Refining Co. in its limestone quarries at Topliff, Utah, by using the mule carts shown in the illustrations. It will be seen that they are little more than a pair of broad-tread wheels, 6 ft. in diameter, which can be backed over a steel pan. The pan is picked up by means of a jack of the lever-and-rack type which stands on the cart axle. The pans are open at the rear end and, in loading, are walled with coarse pieces of rock. The sides of the pans have heavy hooks by means of which they are lifted. The front ends have a smaller hook, which engages the chain from the crank barrel on the shafts, by means of which the pans are dumped, as shown in the illustration. In order to relieve the mule of the load during dumping, an iron strut is placed under one of the shafts. This strut is hinged to the shaft and when not in use lies under the shaft and is held in place by a ring around both shaft and strut. To dump the cart, it is backed against a beam placed in such a position that the pan dumps directly into the crusher. A gallows-frame and chain-block, shown in the illustration are used to handle the heavy parts of the rock crusher, and are not essential parts of the dump.

The shafts are made of 3-in. pipe and are given a good clearance over the pan by the drop axle. The jack is held in position on the axle by means of angle-iron braces, as shown in the illustrations. The upper end of the jack bears against a piece of railroad iron carrying yokes at each end which pass around the axles and terminate in links on their lower ends. These links engage the hooks on the sides of the pans. A quarryman assists the driver to lift the pan with the jack. Many extra pans are distributed along the quarry face, which enables the quarrymen to shovel continuously. The use of these carts makes it necessary to keep the quarry floor level, but this is easily accomplished by spreading some of the fines, which would otherwise be thrown over the dump. It is much cheaper than the upkeep of car tracks. The system is more economical than cars and trackage.



A Convenient Cart for Handling Rock

The cart illustrated is not patented and was designed by the American Smelting & Refining Co.'s engineers. I am unable to give credit for the origin of the idea, as somewhat similar carts are said to have been used elsewhere prior to their installation in the Topliff quarry in 1907.

*Consulting mining engineer, A. S. & R. Co., Salt Lake City, Utah.

Mountain Road Construction

Writing in *Engineering News,* F. W. Harris, recently locating engineer for the Washington state highway commission, gives some pertinent hints as follows:

Dry-laid slope walls are a great aid in maintaining alignment on heavy rock work, as it is not necessary to make the rock cuts so heavy, owing to the saving on embankment quantities by the use of walls. The thickness of a slope wall at the bottom should be 0.6 of the height; the batter, 0.3 ft. to 1 ft.; the thickness at the top, 1½ to 2 ft., and large stones should be set on top of the wall to serve as a guard-rail. The cost is from 70c. to $1.50 per cu.yd. Italians make good wall builders.

It is always a hard matter to get supplies into a mountain country, so that equipment has to be of light weight,

such as picks, shovels, mattocks and wooden wheelbarrows, drill steel and dynamite. This becomes more important where pack-horse trails lead to the work, for then there is no opportunity for hauling material at reasonable cost.

In heavily timbered country, where consistent with drainage, the grade should be laid with an average of 2 ft. in cut. This will place the road on as good a foundation as the country affords. Shallow fills of 1 and 2 ft. should be avoided, as any number of inspectors could not watch station men close enough to keep them from making a shoddy fill. For drainage, 0.5% should be considered a minimum grade.

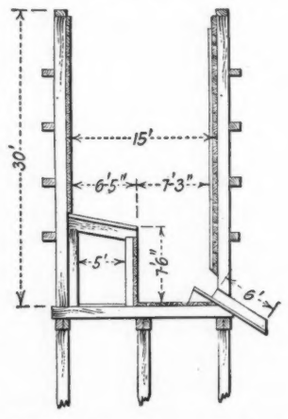
On heavy grades exceeding 3% in sand, clay and earth cuts, the side ditches should be filled with 1 to 2 ft. of gravel or small rocks to prevent scouring and undermining the slope. This protection should be applied when the finishing stakes are set, as it only requires about one day's heavy rain to ruin the toe of the slope in the ditch.

Timber culverts should be used on new work, since waiting for concrete pipes delays the work. All ordinary timber culverts last 10 years and cedar culverts from 20 to 50 years. By the time the culverts are ready for renewal, a better idea of the drainage of the country is obtainable and facilities for hauling cement are better.

It is not advisable to attempt too much refinement in balancing quantities. Excavation should run about 1½ cu.yd. to 1 cu.yd of embankment. In timbered country 10% of the total excavation can be considered as worthless, since it consists of humus, rotten logs, roots, etc. Another 10% should be deducted for quantities lost in blasting stumps. These percentages should each be increased to 15% where excavation averages less than a 3-ft. cut. These percentages also vary with the region. In the Bitter Root Mountains in Idaho they would be about 5% in each case. On the western slopes of the Cascades on the Washington and British Columbia coast, 15% would not be too high.

Bin with Compromise Bottom

A campaign of reconstruction put through in 1914 by the Ellamar Mining Co., of Alaska, involved the building of a new bin at the mine, with a capacity of 1200 tons of copper ore. Among the main features of this bin are its division into three compartments each holding 400 tons, the placing of all tie rods in the partitions so as to protect them from falling ore and particularly the means adopted to overcome the disadvantages of both the inclined and the flat bottom. For this last purpose a housing was built in the lower rear corner of the structure, as shown in the cross-section. The space filled by this reduces by so much the quantity of ore tied up and unavailable, a point of importance when the ore is of high grade, while it provides space for storage when desired; at the same time the difficult and expensive construction of the sloping bottom bin is avoided.



Cross-Section of Bin with New Type of Bottom

Instructions for First-Aid Treatment*

Wounds That Bleed—Abrasions, Cuts, Punctures

Drop 3% alcoholic iodine into wound freely; then apply dry sterile gauze to wound and bandage it. Do not otherwise cleanse wound.

Severe Bleeding

Place patient at rest and elevate injured part. Apply sterile gauze pad large enough to allow pressure upon, above and below wound. Bandage tightly.

If severe bleeding continues apply tourniquet between wound and heart and secure doctor's services at once. Use tourniquet with caution and only after other means have failed to stop bleeding.

Nose Bleeding

Maintain patient in upright position with arms elevated. Have him breathe gently through mouth and not blow nose. If bleeding continues freely, press finger firmly on patient's upper lip close to nose or have him snuff diluted white wine vinegar into nose.

Injuries Which Do Not Bleed—Bruises and Sprains

Cover injury with several layers of sterile gauze or cotton, then bandage tightly. Application of heat or cold may help, other means are unnecessary. If injury is severe place patient at rest and elevate injured part until doctor's services are secured.

Eye Injuries—Except Eye Burns

For ordinary eye irritations flood eye with 4% boric acid solution. Remove only loose particles which can be brushed off gently with absorbent cotton wrapped around end of toothpick or match.

Do not remove foreign bodies stuck in the eye. In that case and for other eye injuries, drop castor oil freely into eye, apply sterile gauze, bandage loosely and go to doctor.

Fire, Electrical and Sun Burns

Do not open blisters. Use burn ointment (3% bicarbonate of soda in petrolatum) freely on sterile gauze applied directly to burn. Cover with several thicknesses of flannel or soft material, then bandage but not tightly.

Acid Burns

Thoroughly flush wound with water, then dry wound, apply burn ointment and bandage as above.

Alkaline Burns

Thoroughly flush wound with water, then flood with white wine vinegar to neutralize (dilute vinegar for alkaline eye burns), dry wound, apply burn ointment and bandage as above.

Dislocations

In case of dislocation of finger except second joint of thumb, grasp finger firmly and pull it gently to replace joint, then place finger in splint and bandage. In other cases rest dislocated part and secure doctor.

Fractures

Make patient comfortable and secure doctor's services at once. Avoid unnecessary handling to prevent sharp edges of broken bones tearing artery. If patient must be moved, place broken limb in as comfortable position as possible and secure it by splint.

Frost Bites

Rub with ice, snow or cold water; treat as "fire burns."

*From a Bulletin of the Conference Board on Safety and Sanitation (National Affiliated Safety Organizations; M. W. Alexander, Secretary, West Lynn, Mass.) Copyright, 1914. Reprinted from "Engineering News."

Chills and Cramps

Give patient 20 to 30 drops of Jamaica ginger in hot or cold water. If no improvement, send for doctor.

Internal Poisoning

Immediately secure doctor's services. Make patient drink large quantities of water, preferably warm, and make him vomit by sticking one's finger down his throat or by other means.

Heat Prostration

Give patient teaspoonful of aromatic spirits of ammonia in hot or cold water. In case body feels warm apply cold to it; if necessary give cold bath. In case body feels cold and clammy, apply heat to it and send for doctor.

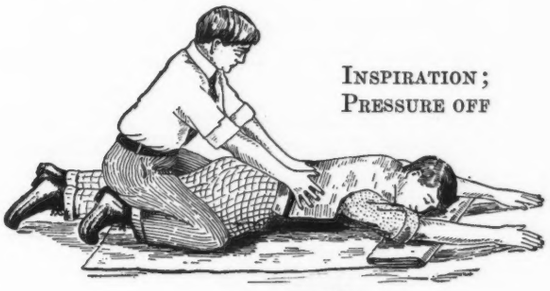
Shock, Following Injury

In case shock is due to severe bleeding, control it first as directed under "severe bleeding" and summon a doctor.

Lay patient flat on back and keep him warm with blankets, hot-water bottles, etc., and provide plenty of fresh air. Let patient inhale fumes of aromatic spirits of ammonia. If fully conscious give patient hot drink or teaspoonful of aromatic ammonia in hot or cold water.

Asphyxiation or Electric Shock

Immediately free patient from electrical circuit, using every care to protect one's self against electric shock. Then if patient is unconscious, even if he appears dead, lay him on his belly with arms extended forward, turn his face to one side, remove false teeth, tobacco, etc., from his mouth and draw his tongue forward.



Inspiration; Pressure off

Expiration; Pressure on

Kneel, straddling patient's thighs, facing his head, and resting your hands on his lowest ribs. Swing forward and *gradually* bring weight of your body upon your hands and thus upon patient's back, then immediately remove pressure by swinging backward. Repeat this movement about twelve times per minute without interruption for hours if necessary, until breathing has been started and maintained (see illustrations).

Meanwhile send for a doctor, have patient's tight clothing loosened, keep him warm and provide plenty of fresh air. Do not give patient liquids by mouth until he is fully conscious.

Protection of Pipe Lines Against Alkali*

The pipe lines serving the California oil fields have frequently to be carried through alkaline soil. The effect of this alkali is to corrode the pipe and in some cases render it useless in a few years. Various attempts have been made to cover the pipe and prolong its life. Asphaltum paint has not been successful. Crude oil runs away through the soil. Quick-setting bituminous enamels put on in a fairly thick layer have had some success, but cannot be applied to a cold pipe or a wet one. The most extensive and successful method devised employs specially prepared roofing paper. Such paper is applied to the pipe in either a spiral wrap or a longitudinal lap. In the spiral wrap the paper is cut at the mill into the desired width, 3 to 12 in., and furnished in lengths of from 50 to 100 ft. As soon as the pipe is screwed together, and before lowering into the ditch, it is coated with hot asphaltum and the wider strip is wound on spirally before the asphaltum sets. There is a crack left by this spiral and this is again coated with hot asphaltum and a 3-in. strip wound over it as a batten. The asphaltum is a thin grade of the ordinary refined product, applied at about 200° F., of such consistence that it will not set for about five minutes after application. At joints, 3-in. strips of paper stuck together with asphaltum are wound around the pipe on each side of the collar until a shoulder is built up flush with the outer circumference of the collar; the sleeve and shoulder are then coated with hot asphaltum and covered with a 12-in. strip of paper. This last strip is bound down with wire, as are also the ends of the spiral wrap.

The longitudinal lap system has been more extensively used. For this the paper is delivered in rolls about 6 in. wider than the pipe circumference and about 72 ft. long. The paper is applied by coating the pipe with hot asphaltum, wrapping the paper around it and sticking it down with the same material. When the oil is to be pumped hot the paper is not always stuck down, since it is calculated that the effect of the heat from the oil and the pressure of the earth will result in its sticking. It is a question, however, whether wrinkles and cracks will not develop in such cases. The lap should always be made on top of the pipe, with the outer portion looking down, and wires should be placed about every 16 in. in order that the weight of the paper itself will not pull it away from the pipe. The joints are protected by building up shoulders as with the spiral wrap.

Bunker Hill & Sullivan Storage Battery Haulage

In a paper presented before the February meeting of the A. I. M. E., the following advantages of storage-battery locomotives were noted: (1) Elimination of the dangerous trolley wire; (2) easy access to the face; (3) elimination of the cost of installation and upkeep of trolley wires and track bonding; (4) elimination of the danger of electrolysis from stray trolley currents. These advantages, with other minor points, result in a high degree of safety, economy and efficiency; the storage-battery haulage system has given excellent satisfaction.

*Abstract of an article by C. P. Bowie in "California Journal of Technology," November, 1914.

Details of Milling and Smelting

Handfiring in Waste-Heat Boilers*

In view of the extensive use of waste-heat boilers in metallurgical operations, the following article from *Power*, Feb. 9, 1915, by Osborn Monnett, will be of interest. Mr. Monnett deals particularly with making waste-heat boiler installations capable of hand-firing.

A typical installation is shown in Fig. 1. This boiler receives the waste gases from a billet-heating furnace, the

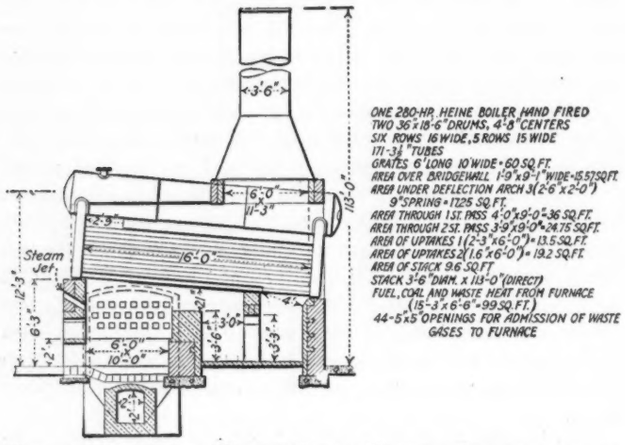

ONE 280-HP. HEINE BOILER, HAND FIRED
TWO 36"x18'-6" DRUMS, 4'-8" CENTERS
SIX ROWS 16 WIDE, 5 ROWS 15 WIDE
171-3½" TUBES
GRATES 6' LONG 10' WIDE = 60 SQ.FT.
AREA OVER BRIDGEWALL 1'-9"x9'-1" WIDE = 15.57 SQ.FT.
AREA UNDER DEFLECTION ARCH 3(2'-6"x2'-0")
9" SPRING = 17.25 SQ.FT.
AREA THROUGH 1ST. PASS 4'-0"x9'-0" = 36 SQ.FT.
AREA THROUGH 2ST. PASS 3'-9"x9'-0" = 24.75 SQ.FT.
AREA OF UPTAKES 1(2'-3"x6'-0") = 13.5 SQ.FT.
AREA OF UPTAKES 2(1.6'x6'-0") = 19.2 SQ.FT.
AREA OF STACK 9.6 SQ.FT.
STACK 3'-6" DIAM. x 113'-0" (DIRECT)
FUEL, COAL AND WASTE HEAT FROM FURNACE
(15'-3"x6'-6" = 99 SQ.FT.)
44-5"x5" OPENINGS FOR ADMISSION OF WASTE GASES TO FURNACE
Steam Jet
3'-6"
16'-0"
10'-0"
113'-0"

FIG. 1. TYPICAL WASTE-HEAT BOILER SETTING WITH AUXILIARY HAND-FIRED FURNACE

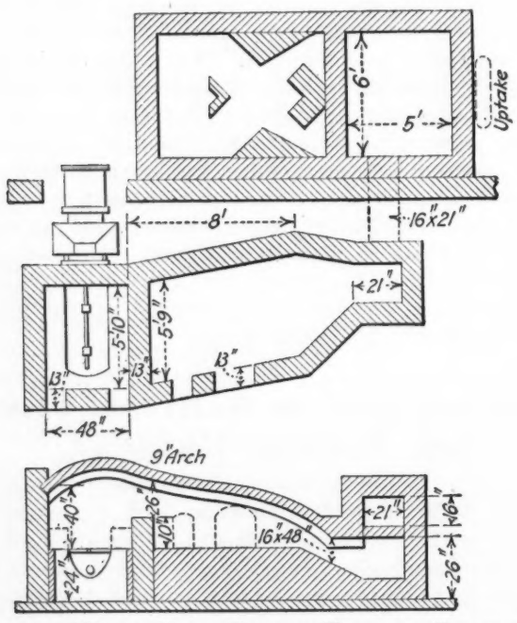


FIG. 2. WASTE-HEAT RETURN-TUBULAR BOILER AND FORGING FURNACE WITH UNDERFEED STOKER

gases coming through the perforated side walls of the setting. When this furnace is not in use the boiler can be fired by hand in the usual manner. As shown, the setting consists of a standard tile-roof furnace, with deflection arch, siphon steam jets and panel doors. Many metallurgical furnaces have underground breechings and it is generally simple to lead the gases to the boiler.

The underfeed type of stoker is especially adapted for the smokeless operation of metallurgical furnaces because it does not depend on natural draft for its air supply. Owing to the length of the gas passes and number of turns, etc., there is generally but little suction over the fire from natural draft. Any stoker depending on natural draft and an ignition arch is at a big disadvantage from the standpoint of maintenance and capacity. An under-

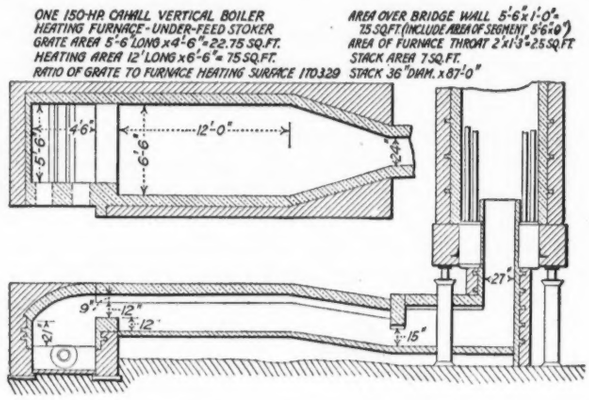

ONE 150-HP CAHALL VERTICAL BOILER
HEATING FURNACE-UNDER-FEED STOKER
GRATE AREA 5'-6" LONG x 4'-6" = 22.75 SQ.FT.
HEATING AREA 12' LONG x 6'-6" = 75 SQ.FT.
RATIO OF GRATE TO FURNACE HEATING SURFACE 1 TO 3.29
AREA OVER BRIDGE WALL 5'-6"x1'-0" = 7.5 SQ.FT. (INCLUDE AREA OF SEGMENT, 5'-6"x9")
AREA OF FURNACE THROAT 2'x1'-3" = 2.5 SQ.FT.
STACK AREA 7 SQ.FT.
STACK 36" DIAM. x 87'-0"
5'-6"
4'-6"
12'-0"
6'-6"
24"
27"
9"
12"
12"
15"

FIG. 3. AMERICAN UNDERFEED STOKER AND HEATING FURNACE CONNECTED TO 150-HP. CAHALL BOILER

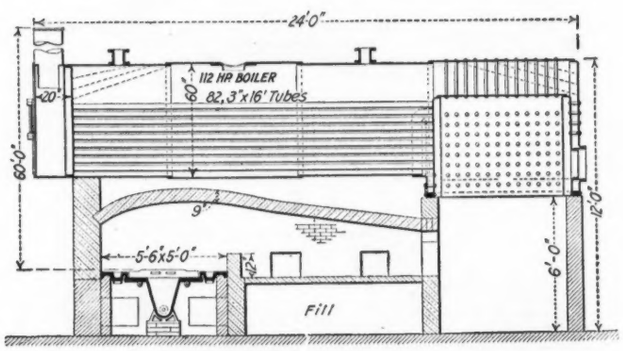


FIG. 4. AMERICAN UNDERFEED STOKER AND FORGING FURNACE WITH 112-HP. FIREBOX BOILER

feed stoker will operate satisfactorily under conditions where a natural-draft stoker would burn up from the heat bottled in the furnace.

Fig. 2 shows a waste-heat boiler of the horizontal return-tubular type installed in connection with a reheating furnace having an underfeed stoker. The boiler itself is equipped for hand firing, an ordinary No. 8 furnace containing a pier and wing walls being installed behind the bridge-wall. The usual rules for furnace areas based on the grate surface are followed. If the boiler is to be used much, independently of the waste-heat furnace, the

*Copyright, 1915, by Osborn Monnett.

same stack height required by an independent boiler should be provided.

Another combination of metallurgical furnace and waste-heat boiler is shown in Fig. 3. In this case the ratio of grate to metallurgical heating surface is given as 1:3.29. The gases pass up through the lower drum of a specially constructed Cahall vertical boiler. Obviously, the proportions of the furnace depend on the product to be heated, so that the design must be varied to suit the conditions. The accompanying illustrations merely indicate how the different combinations can be operated without smoke.

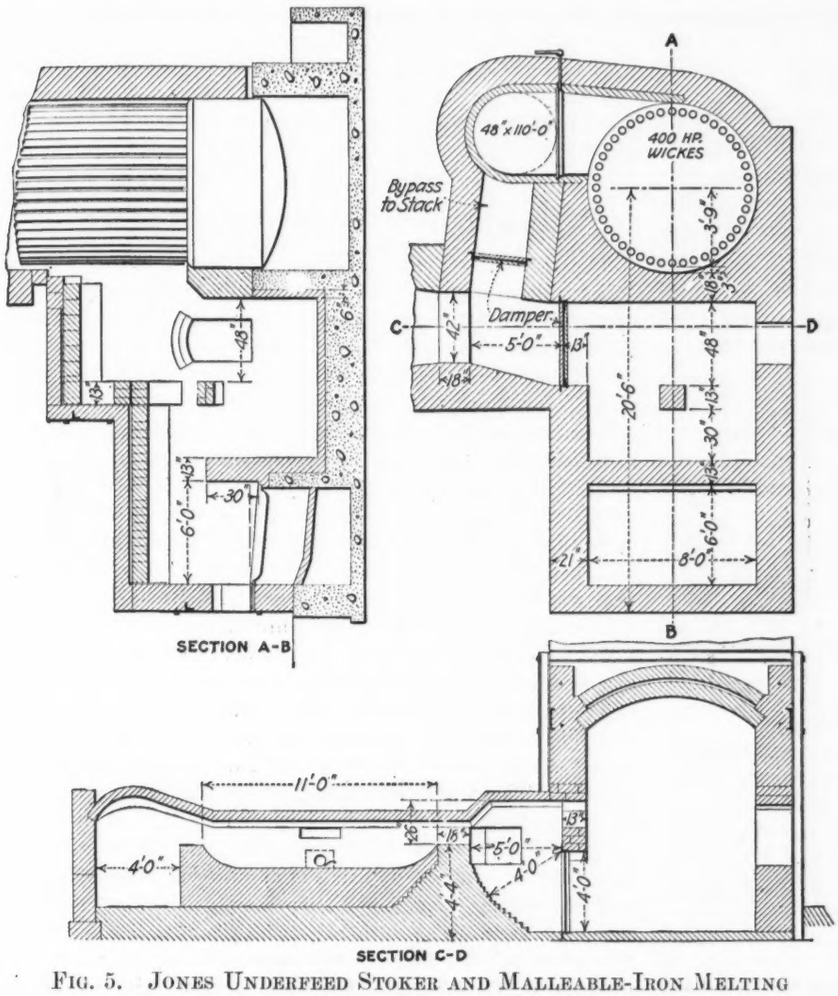


FIG. 5. JONES UNDERFEED STOKER AND MALLEABLE-IRON MELTING FURNACE WITH 400-HP. WICKES WASTE-HEAT BOILER

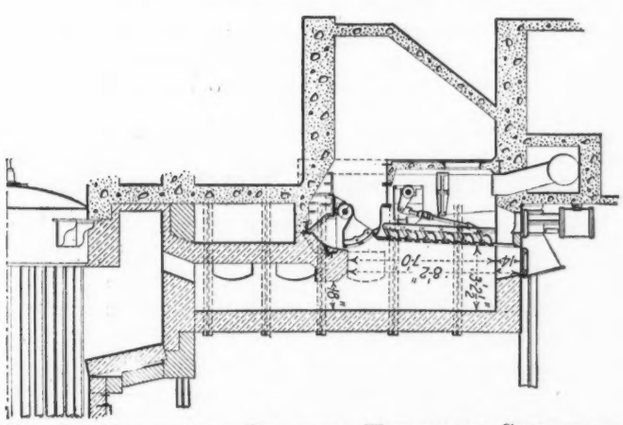


FIG. 6. JONES SELF-CLEANING UNDERFEED STOKER IN FORGING FURNACE AND WICKES WASTE-HEAT BOILER

Forging furnaces are often connected to waste-heat boilers, as the steam raised by the boilers can be used to advantage in the steam hammers, the same fuel sufficing for all operations in the shop. Fig. 4 shows an interesting and compact installation of this kind, consisting of a 112-hp. firebox boiler over a forging furnace fitted with an underfeed stoker.

When hand fired, the malleable-iron melting furnace produces a great deal of smoke. The underfeed stoker can be applied to this furnace with advantage and the waste heat used for steam making, as shown in Fig. 5. The latter consists of a 400-hp. Wickes waste-heat water-tube boiler attached to a melting furnace using an underfeed stoker and having an auxiliary hand-fired furnace for emergency purposes. With a bypass to the stack the melting furnace can be operated when the boiler is down for cleaning or repairs. Also, the furnace can be cut off from the boiler and the latter operated independently by closing the firebrick curtain-wall or damper, as indicated in the drawing. This makes a flexible combination. Another forging furnace with a Jones self-cleaning underfeed stoker is shown in Fig. 6, attached to a Wickes waste-heat boiler.

Fettling Reverberatory Furnaces at Steptoe

In fettling the reverberatory furnaces at the Steptoe works at McGill, Nev., R. E. H. Pomeroy states[1] that it has been the practice for the last five years to make use of all converter secondaries, there being no blast furnace at this plant for disposing of this material. This byproduct is used more particularly along the firing wall or at some point where heavy material is required to sink into the bath and form a secure foundation at the furnace side for siliceous fettling above and on the slag line. The principal siliceous fettling used is mill slimes or siliceous concentrates. The furnaces are fettled daily by hand, using shovel and ladle, and about 30 tons of this material are used per furnace day. No brick side-door coverings are used as each door is provided with an outside sill or shelf and the openings are piled full of fettling material.

Tin Deposition from Mineral-Acid Solutions was tried by Frank C. Mathers and Barrett W. Cockrum (American Electrochemical Society's October, 1914, meeting). Fluoride, chloride, perchlorate and fluoborate solutions were tried with clove oil, peptone, gelatin, glue, phloridizin, sandalwood oil, aloes, tannic acid, levulose, eucalyptus oil, catechu, benzoic acid, caffeine, pyrogallol, formin, licorice, oxalic acid, salicin, saponin, podophyllin, jalapin, digitalin, morphine and gum arabic. None of the deposits was good, and the authors state any further work should be done with other addition agents.

[1] "Bull. of A. I. M. E.," February, 1915.

Company Reports

Oroville Dredging

The following is an abstract of the Oroville Dredging Co., San Francisco, Calif., for the year ended July 31, 1914. A total of 2,897,557 cu.yd. of material was excavated. Total expenditures were $143,152 of which $117,246 were for operations. Net bullion returns were $251,599 and miscellaneous earnings, $8357; total receipts, $259,956, making a net profit of $116,804 before charging depreciation on capital accounts. Balance to surplus after all charges was $73,903. The accompanying table of costs, which covers only operating expenses, shows a cost of 4.04c. To this must be added 0.9c. for expenses not charged to operations and about 1.8c. for charges at San Francisco and depreciation charged for dismantlement of dredges. This makes a total of about 6.74c. per cu.yd.

OPERATING COSTS OF OROVILLE DREDGING, LTD., PER CUBIC YARD

Dredges	Boston 4	Exploration No. 2	Exploration No. 3	Total and Average
Total dredging time	7,538 hr.	3,578 hr.	7,529 hr.	18,645 hr.
Cu.yd. excavated	1,217,957	340,387	1,339,213	2,897,557
Average depth, ft.	30.5	31.5	30.2	30.5
Labor and material	1.31c.	1.6c.	1.07c.	1.25c.
Electric power	0.79c.	0.90c.	0.67c.	0.75c.
Water	0.07c.	0.11c.	0.07c.	0.08c.
Repairs	1.43c.	0.92c.	0.75c.	1.06c.
Smelting and express	0.03c.	0.05c.	0.03c.	0.03c.
General expenses	0.62c.	1.17c.	0.56c.	0.66c.
Taxes and insurance	0.30c.	0.24c.	0.19c.	0.21c.
Total operating	4.55c.	4.99c.	3.34c.	4.04c.
Average daily yardage	3,336	1,967	3,641	3,208
Actual dredging time, hr. and min. daily	20 39	20 41	20 37	20 38
Acres dredged, year	24.70	6.70	27.40	58.80
Bullion returns	8.58c.	12.79c.	7.72c.	8.68c.
Net revenue, operating	4.03c.	7.80c.	4.38c.	4.64c.

Average cu.yd. per acre, 49,278.
Average yield per acre, $4278.
Average operating expenses per acre, $1994.

Nevada Wonder

The report of the Nevada Wonder Mining Co., Wonder, Nev., for the year ended Sept. 30, 1914, shows a total production of 48,570 tons of ore having an average value of $15.52 per ton of which 93.2% was recovered by the mill. A summary of cash statements shows that total receipts were $664,862 and operating expenditures, etc., $441,820, leaving a profit balance of $223,042. Dividend payments amounted to $281,636, making a decrease of $58,594 in cash on hand reported at Sept. 30, 1913. The operating statements of the mining and milling company give the following costs:

	1912-13	1913-14
Mining cost per ton of ore	$3.37	$4.70
Shaft sinking per ton of ore	0.31	0.55
Enlarging shaft per ton of ore	0.18	0.04
Milling per ton of ore	3.25	3.37
Marketing products per ton of ore	0.24	0.28
Total cost per ton ore	$7.35	$8.94
Average value per ton of ore	$14.63	$15.52
Loss in tailings per ton of ore	0.93	1.06
Recovery per ton of ore	$13.70	$14.46
Less total cost per ton of ore	7.35	8.94
Profit per ton of ore mined and milled	$6.35	$5.52

Development work amounted to 11,276 ft., making the total to date 29,916 ft. The cost of drifting, crosscutting and raising averaged $6.44 per ft. and shaft sinking $30.80 per ft. for the Hidden Treasure shaft to $38.53 per ft. for the Nevada Wonder shaft. The stamp duty was 13.31 tons per stamp per 24 hours.

Stratton's Independence

The report of the Stratton's Independence Mine, Victor, Colo., for the year ended June 30, 1914, shows a profit of $71,941 after deducting London-office expenses. Development work was chiefly confined to proving up the mill veins at greater depths and following them southward into the granite area. It is stated that the work in the productive area of the Independence did not disclose any new ore. The mill veins are today the sole source of shipping ore produced by the company. The lessees produced 18,736 tons which was sorted down to 7782 tons of ore having a gross value of $158,173 and a net value of $109,428 after payment of freight and treatment charges, of which the company got $34,991 for royalties and charge on profits. The company produced 19,785 tons of shipping ore which was sorted down to 3899 tons having a gross value of $68,740 and a net value of $46,806 after payment of freight and treatment charges. In addition to this ore the company treated for its own account 46,527 tons of ore in its mill, averaging $2.84 per ton. There were also 133,875 tons of dump ore treated. The average of all ore treated was 0.14396 oz. of gold per ton of which 80% was recovered. The cost of milling including moving dump ore was as follows: Coarse crushing and sorting, 15.63c. per ton; fine crushing, concentrating and treating concentrates, 50.40c.; cyaniding and special chemicals, 46.72c.; miscellaneous, 14.25c.; mining dump ore, 11.1c.; total, $1.3810 per ton milled. It is expected that the dump ore will be exhausted this year. In speaking of the future it is stated that the company expects to be able to mine a grade of mill ore from the Independence that will pay the expense of mining and milling and that some profit may come from occasional finds of shipping ore.

Temiscaming & Hudson Bay

The report of the Temiscaming & Hudson Bay Mining Co., New Liskeard, Ont., for the year ended Aug. 31, 1914, shows a dividend payment of $91,132 for the holding company, but it is stated that no dividends were received from the operating company because of the purchase by that company of the control of the Dome Lake Mine at Porcupine. The report of the operating company shows a total income of $198,082 and a total expenditure of $145,522 leaving a profit of $52,560. The end of the ore reserves of No. 1 mine was reached in June and the property was closed down in July. The production for the 10 months was 393,360 oz. of silver having a net value of $196,435. The total production from this property since the mine was opened in 1907 has been 5,604,-

168 oz. having a gross value of $3,120,514 and a net value of $2,825,561. No ore has been developed in No. 2 workings, but the prospects are considered favorable. The total cost of producing silver during the year was 25.2c. per oz., freight and smelter deductions alone amounting to 7.19c. The total cost of mining, including stoping, tramming, pumping, hoisting and depreciation, was $3.08 per ton. A record of the concentrating plant shows that 18,581 tons were treated averaging 19.5 oz. of silver, of which 86.3% was extracted. The ratio of concentration was 40:1 and the cost was $1.59 per ton for operating expenses only.

Utah-Apex

The report of the Utah-Apex Mining Co., Bingham, Utah, for year ended Aug. 31, 1914, shows a profit of $54,561 from the sale of 121,675 tons of ore. It is estimated that the net earnings would have been $122,159 greater had the company obtained the same price for lead as the previous year. Milling operations were suspended for two months on account of construction work in connection with increasing the capacity of the mill. The mine was also forced to close its entire plant for a time on the order of the local sheriff in an effort to secure the Mexican desperado Lopez, who was known to be hiding in the mine. Development work account standing on the books as an asset was charged off at the rate of 50c. per ton of ore mined so that this account now stands at $138,876 instead of $199,714 as reported last year. The outstanding bond indebtedness was reduced $68,000, face value, during the vear, leaving a total of $105,000 now outstanding.

During the month of September the mill treated 8253 tons of ore yielding 2800 tons of concentrates. It is expected that the recent installations in the mill will bring the daily capacity of the mill to 100 tons of concentrates a day. A fire brigade has been organized among the employees and weekly drills are the rule. A 60,000-gal. water tank has been installed just above the mill and is to serve for fire purposes only. Mule haulage has been replaced on the 700 level by electric haulage.

Camp Bird

The report of the Camp Bird, Ouray, Colo., for year ended June 30, 1914, shows a profit on its Camp Bird property of $437,848. This amount is reduced to $322,-468 by the London office after deducting directors' fees and other office charges and adding receipts from interest and miscellaneous income. To make a dividend payment of $221,130, provide for income tax, losses on loan accounts, payments on new property, depreciation on investment, etc., about $244,424 was apparently drawn from the reserve in addition to the net balance stated above.

A reorganization of the company's affairs has taken place owing to the failure of some English houses in which the former chairman was interested. H. C. Hoover is the new chairman. A technical committee has also been formed, of which R. J. Frecheville is chairman. In addition to the Camp Bird property the company is also interested in the Santa Gertrudis, the Messina (Transvaal) Development Co., the Central American Goldfields Syndicate, and other mining companies.

The ore reserves at the Camp Bird were estimated to contain 25,709 tons of ore that would yield a profit of $307,648. The mills treated 30,595 tons of ore yielding an average of $26.19 per ton; of this, 52.97% was recovered by amalgamation, 42.07% by concentration, and 4.96% by cyanidation. The contents recovered averaged 1.135 oz. gold, 4.27 oz. silver, 1.324% lead and 0.26% copper per ton of ore.

Consol. Mining & Smelting Co.

The report of the Consolidated Mining & Smelting Co. of Canada, Trail, B. C., for the year ended Sept. 30, 1914, shows a net profit of $474,012 after writing off $193,149 for depreciation. Out of this four dividends aggregating $464,376 were paid. In addition to these expenditures the plant account was increased $366,567 and property account $283,422. These expenses which were paid out of surplus or by borrowed money have placed the company's cash account in a bad position. Overdrafts and interest due banks now amount to $1,438,904, but the value of the metals shown in the statement of assets amounts to a little more than the amount due banks. Cash on hand totaled $2978. The total tonnage smelted at Trail was 374,771 tons having a gross value of $6,000,-662. The metals produced from this ore were as follow: Gold, 129,083 oz.; silver, 2,568,301 oz.; lead, 34,-617,318 lb.; copper, 3,645,997 lb. Development work totaled 33,146 ft. and diamond drilling 28,896 ft. It is stated that the development at the Rossland mines and also at the Sullivan group is encouraging.

Davis-Daly

The report of the Davis-Daly Copper Co., Butte, Mont., for the year ended June 30, 1914, shows that 52,198 dry tons of ore were shipped for which it received $268,178. Other receipts from rentals, royalties, etc., brought total receipts to $271,973. Expenditures totaled $379,993 which is $108,020 in excess of receipts. Since Apr. 1, 1914, operations have been confined wholly to development on the 1400 and 1700 levels and sinking the Colorado shaft which has been extended to a depth of 2346 ft. It is stated that a vein of commercial ore was encountered about 250 ft. below the 1900-ft. level. The report shows a balance of $258,850 in current assets of which $171,591 is in unpaid assessments.

South American Copper Syndicate

The report of the South American Copper Syndicate, an English corporation operating the Aroa or Quebrada mines, Aroa, Lora, Venezuela, for year ended June 30, 1914, shows a net profit of $52,210 and dividends paid aggregating $34,423. It is stated that the total cost of mining and transporting several thousand of tons of ore shipped to smelters has been charged as a part of the year's expense, but no credit for the value of this ore is taken in the accounts. A smelter for the treatment of low-grade ores is under construction, but owing to several mechanical breakdowns and other difficulties it has not yet been completed. Only ore averaging about 8% copper is sent to Europe for treatment.

Correspondence and Discussion

Capital and Labor

ARE LABOR ORGANIZATIONS AND SENTIMENTAL THEORISTS ALONE ENTITLED TO BE HEARD IN FRAMING LEGISLATION, OR SHOULD CAPITAL INSIST UPON THE RIGHT TO BE REPRESENTED?

The Congress and the legislatures of 48 states of the Union are daily engaged in the discussion and enactment of laws regulating industry and commerce. In the preparation and consideration of these laws Union Labor and every other factor except the main factor in production and distribution, as well as many sentimental societies which are not at all factors in either the production or distribution of wealth, are represented. They are not only present at the hearings before committees as accredited agents of organizations, but they exercise a subtle and powerful influence upon all legislators by the threat and the exercise of influences "at home" in the legislators' districts.

All interests except the most important are fully represented. While the present industrial system endures—and all history teaches that it will endure as long as civilization continues—the greatest of all factors in the production and distribution of wealth is the man of initiative, the man of organizing and administrative capacity, who can secure the necessary capital for the institution of industry and can conduct that industry so that labor and capital may both secure a fair return therefrom.

All know that Union Labor as now organized could not entirely manage any industry it today dominates and secure for the members of its organization the daily returns which they now enjoy, even if the labor organizations were presented with or should be permitted to confiscate the capital now used in that particular industry. The logical thinkers of the labor movement attempt to avoid the force of this fact by the advocacy of the confiscation of all capital, so that there would be no competition against a system where there would be no incentive to initiative, to industry, to improvement. The great majority of the people of the United States believe in the much denounced "Capitalistic System" of production. All rights to property in the United States rest upon the acquiescence of the majority in such rights and to the belief of the said majority that said "Capitalistic System" most conduces to the common good.

If this were not so, with the persistent activity of the insistent minority and the apathy of the majority which has continued for the past decade, all rights of property would long ago have been swept away and the Commune would, ere this, have been instituted in America.

To the work of calling the attention of the electorate to the subtle and insidious invasions by legislation of the rights in which they believe; to the illustration of the infraction of fundamental principles; in the fair and open presentation of the rights to property before legislators considering the regulation by law of industry and commerce, the employers have, thus far, done practically nothing in a proper and permanently effective manner. Generally, capital has too serenely relied upon the judiciary to protect constitutional rights, until now adverse legislation has gone so far and, by reason of the silence of those whose rights are invaded, is so vociferously supported by the minority that a general public sentiment appears to have been created (although in fact it has not) and the judiciary itself is under the influence of this sentiment and is ignoring or misconstruing constitutional provisions in obedience to this, seemingly, great popular demand.

Such resistance as has been made to these influences and activities of the minority has been made by organizations like the Citizens Industrial Association which pursued weak methods in an attempt to defend rights under the law. Whenever it shall become necessary to conspire to uphold the laws, then law is at an end.

Whenever it becomes necessary to bribe to secure the enforcement of law then the law had better remain unenforced. It is not necessary to employ agents secretly to uphold the rights to property. It is not wise timidly to beg from legislators to be accorded as privileges or immunities that which 90 per cent. of the community recognize to be rights under a constitutional government.

The time has come when the men whose brains, energies and money make the opportunities for industry and commerce must boldly and effectively assert themselves as factors to be considered in legislation in order to end this saturnalia of unequal, oppressive and unjust legislation. Labor associations have come to stay. No sane employer now denies the right of employees to collective bargaining and to coöperative action for their protection. These associations, however, must be compelled to incorporate under the law; they must be held to such responsibility as attends all others who enjoy rights under the laws.

How shall employers assert themselves? How shall those who advocate equal laws and the abolition of unnecessary and oppressive laws make their influence felt? In what manner should they coöperate? It is only by the maintenance of a permanent and vigilant organization that any effective coöperation may be secured. What shall be the scope and what the limitations of such an organization? How shall such an organization when formed be kept from abusing its powers, from employing illegal methods upon the false idea that the end may justify the means? How shall it be kept from becoming the agency of some particular interest; from advancing the personal ambitions of some individual; from being the annex to some political party?

Union Labor knows all political parties—uses all of them—and ties itself to none.

Its membership almost to a man supports the political party which, at the moment, is by its candidates and propaganda particularly advancing the interests of Union Labor; but Union Labor, as an organization, does not commit itself to the support of any political party. An employers' organization, if advocating the enforcement of ordinary rights under the law, should compel the recognition of such rights by all parties and should not fear to

condemn the platform or the candidate of any party which denies such rights. It should be equipped to present the employers' side of every controversy wherever legislation is pending. It should assist in the defense of its members whenever the general rights of property are denied and wherever and whenever such rights are collectively assaulted.

It should seek to enforce indemnity for every destruction of property by organizations of labor; it should assist in the preparation and dissemination of expressions calculated to increase the respect for and observance of just laws and should advocate the repeal of unjust laws; it should foster and encourage the development of this country's resources and further the extension of commerce abroad.

To these ends and for these purposes the American Society of Industry and Commerce should be organized with headquarters in Washington, D. C. The initiation fees and annual dues should be within the means of the small manufacturer and small business man. It should encourage and assist the organization of a mutual insurance fund for indemnity for losses by unprovoked strikes. It should issue a weekly or monthly bulletin at Washington similar to that issued by the American Federation of Labor. The operations at Washington and the control of the National organization should be in the hands of a board of one hundred governors to be selected, at least one, from each State. It should openly maintain a legislative bureau at Washington and one in each State for the purpose of properly presenting facts and arguments publicly. It should have an annual convention. Each State should comprise a district under the direct charge of a District Board. The district board should have a dinner or luncheon conference quarter-yearly, to be attended by the members of that district and the visiting members of other districts. Each district bureau should be encouraged and assisted in its work by the National organization.

As it is now, no legislator dares defend the rights of employers. To do so, marks him as the victim for an assault by Union Labor—with no organization to dispute Union Labor's impudent claim of right completely to control legislation.

This organization would, at least, crystallize existing sentiment in America so that legislators would learn that rights are not entirely confined to that class so vociferously represented by the walking delegate. The mining industry should be vitally interested in such an organization, but it should not be confined to any industry. It should represent those who believe that America is still a land of opportunities, that individuals are not securely chained to their environment and that the culture of the "class-conscious" microbe is not necessary to the preservation of society. It should embrace in its membership all who believe in a government of few, simple, sane, just laws; all who realize that the multiplication of unnecessary laws and the administration thereof by a bureaucracy are a menace to constitutional government and a barrier to the extension of legitimate industry and commerce. With such an organization in existence the millions who now are mute would have the courage to express in actions their deep convictions.

H. J. CANTWELL.

St. Louis, Mo., Jan. 15, 1915.

The Union Sulphur Refineries in France

As a reader of the JOURNAL I would like to make correction of a statement I find in the number of Nov. 21, 1914, under the heading, "By the Way." This is an article referring to the sulphur refineries of the Union Sulphur Co. at Marseilles and Cette. Your correspondent has certainly exaggerated very much the risk to those works by speaking of their possible destruction. In France we have not destroyed nor injured any industrial establishment owned by a foreigner. The industries owned by enemies have been put under close supervision, but not confiscated nor destroyed by the Government. Those owned by foreigners not enemies have not been subjected to any special treatment.

The destruction and ruin of foreign industrial works and enterprises has remained the monopoly of the German army, in its operations.

I have written you, because I do not wish to see a misstatement about my country in the JOURNAL, which is so influential and usually so correct and careful in its statements. Perhaps it would have been better to give the direction of these works to Americans, or in their absence to Frenchmen rather than to Germans; but that is outside of the intention of my letter.

H. KNOERTZER,
Engineer of Mines.

Paris, Dec. 16, 1914.

The Uses of Brothers-in-Law

Misther Editor: Have ye iver noticed that manny a convaynient minin' tool is niver mintioned in the textbooks an' other sich compindiums av misinformayshun?

Wan av these is the *cuñado*. A *cuñado* niver occurs ixcipt as a byproduct av the most important industry. Some fellies commit matrimony with the delib'rate intinshun av manufacturin' thim into minin' tools; while other fellies may acquire *cuñados* unbeknownst an' use thim as makeshifts.

'Tis most distressin' for a felly to use a *cuñado* jist to make its sister happy, usin' it kind an' gintle, feedin' it lib'ral salary, playin' the minin' game fair an' square an' accordin' to the rules; an' thin all at wance, whin the *cuñado* l'arns a little, it goes off an' plays dirty tricks av its own invinshun, givin' folks an incorrect impreshun av its early trainin'.

But the most convaynient thing about a brother-in-law is the hind-name bein' different. A promoter can use his *cuñado* for ingineer or superintendent av the mine, an' no wan but the inishyated need know. What a cinch old Brigham Young wud have had as a minin' promoter.

BILL MCGINTY.

New York, Feb. 4, 1915.

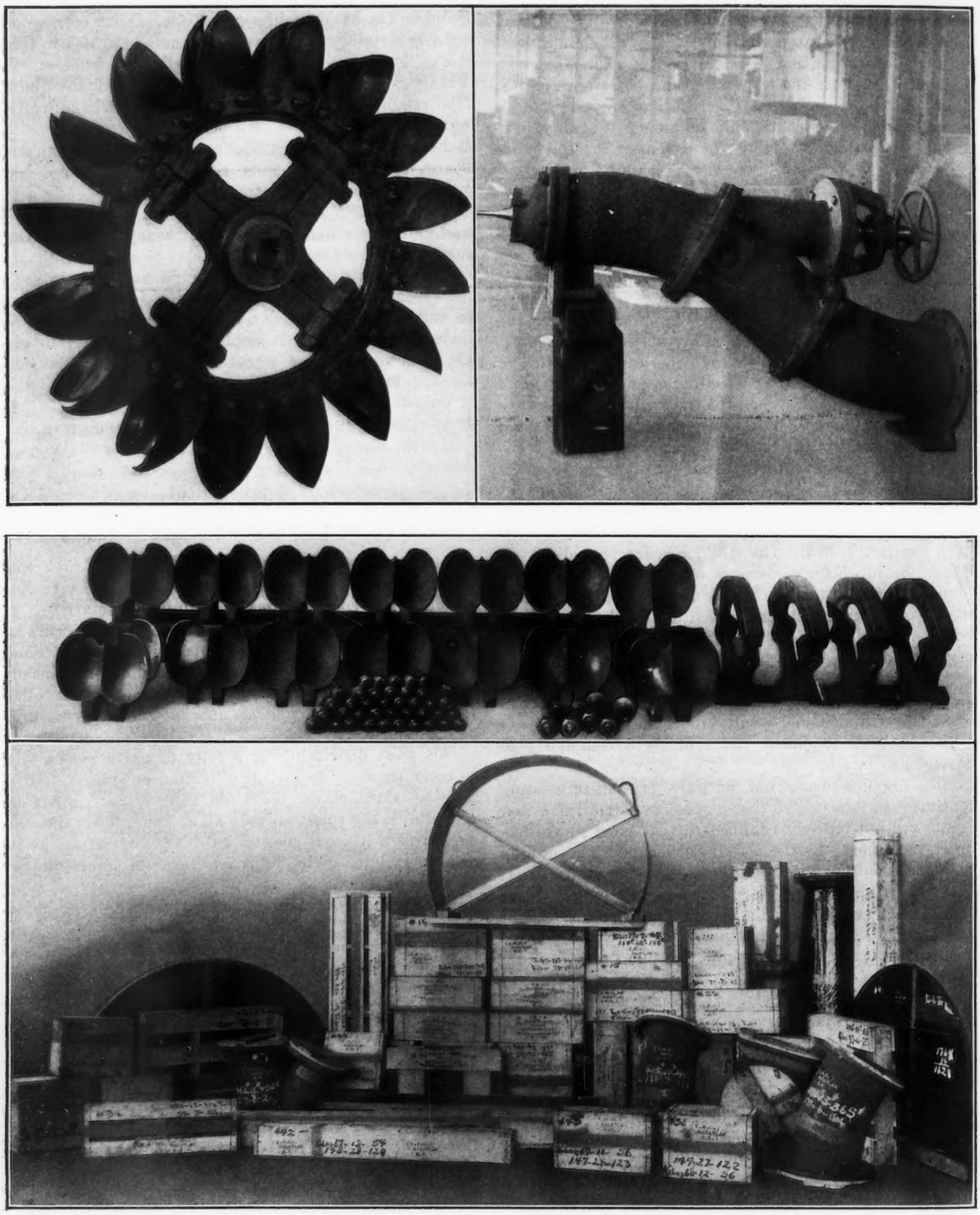
Mining in Colorado

In the article on "Metal Mining in Colorado in 1914," I spoke of the Wanakah orebodies at Ouray as being replacement deposits in quartzite. This is an error and should read "limestone" instead of "quartzite."

GEORGE E. COLLINS.

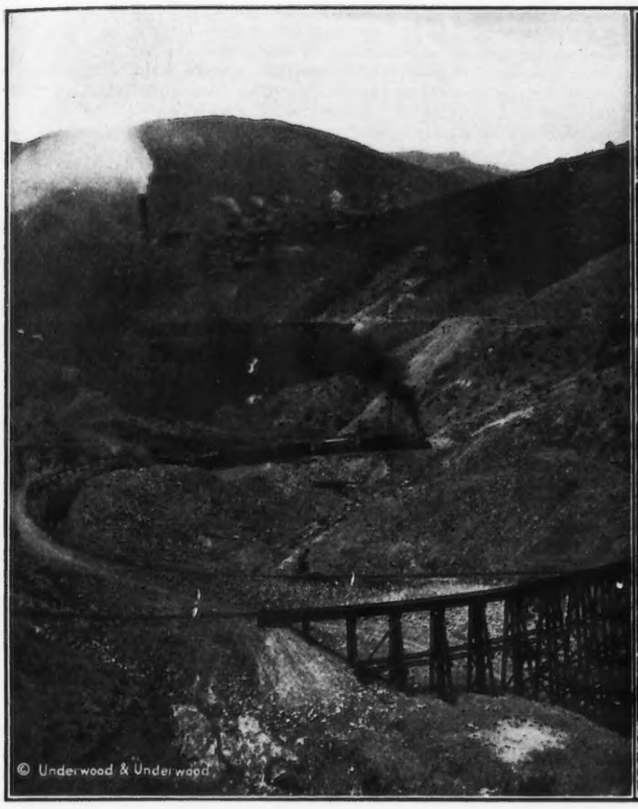
Denver, Colo., Feb. 1, 1915.

Photographs from the Field

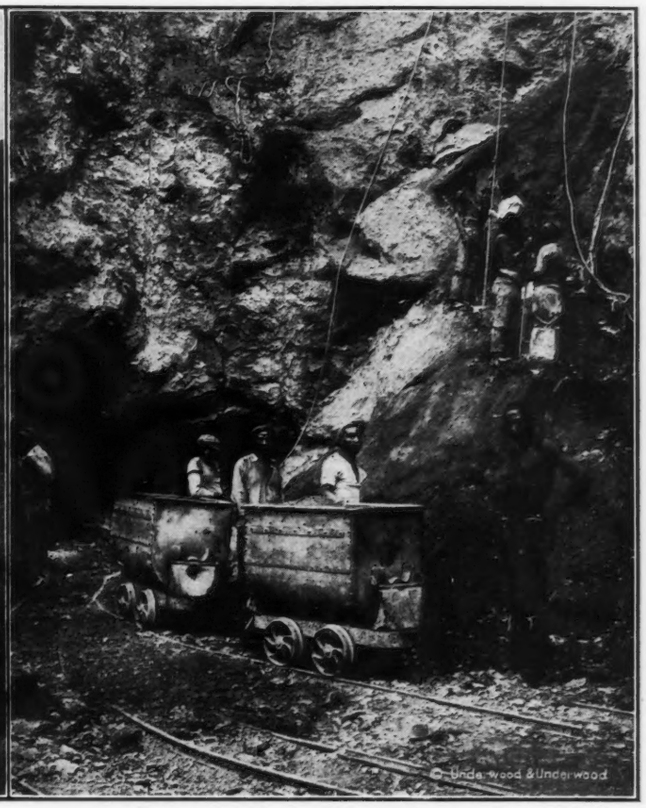


PACKING MACHINERY FOR MULE-BACK TRANSPORTATION

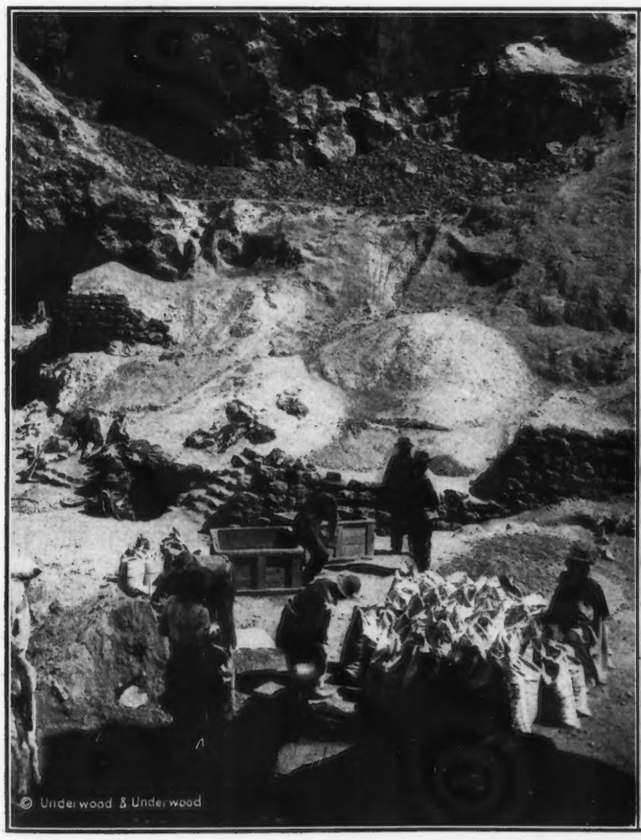
An example of how machinery should be packed for export and mule-back freighting. A Pelton wheel and nozzle shown in the upper illustrations, the wheel dismantled, and the whole packed

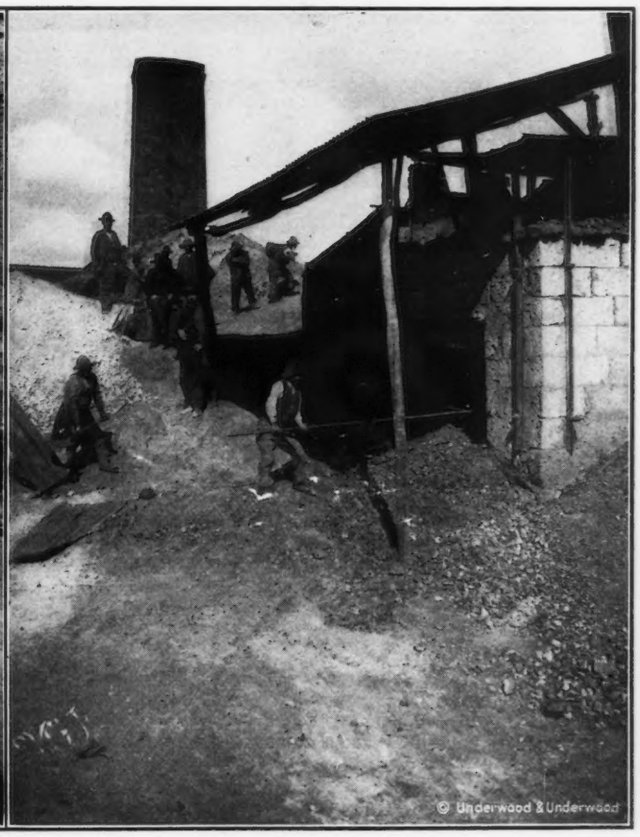


MORENCI SOUTHERN R.R. JUST BELOW MORENCI



WESSELTON DIAMOND MINE, KIMBERLEY, S. A.





NATIVE COPPER MINING IN PERU

Carrying ore in leather bags

A native smeltery

NEW PUBLICATIONS

ELECTRICITY IN COAL MINING. By David R. Shearer. 6¼x9¼, pp. 84, illus.; $1.50. McGraw-Hill Book Co., New York.

HANDBUCH DER MINERALCHEMIE. Vol. III, Part 5. 7x10, pp. 159, paper; 6.50 marks. Theodor Steinkopff, Dresden, Germany.

THE PRESERVATION OF STRUCTURAL TIMBER. By Howard F. Weiss. 6x9½, pp. 312, illus.; $3. McGraw-Hill Book Co., New York.

THE PETROLEUM YEAR BOOK, 1914. Compiled by Sydney H. North. 5½x8¾, pp. 104, illus.; $2. The Technical Book Shop, London, Eng.

HANDBUCH DER MINERALCHEMIE. Vol. II, Part 6. By C. Doelter. 7x10, pp. 160; 6.50 marks. Theodor Steinkopff, Dresden, Germany.

MINERAL PRODUCTION OF CALIFORNIA FOR 1913. By E. S. Boalich. Pp. 140, illus. Bull. 63, California State Mining Bureau, San Francisco.

LEAD AND ZINC DEPOSITS OF NORTHWESTERN ILLINOIS. By G. H. Cox. Pp. 120, illus. Bull. 21, Illinois State Geological Survey, University of Illinois, Urbana, Ill.

THE PRODUCTION OF PETROLEUM IN 1913. By David T. Day. Mineral Resources of the United States, 1913, Part II. Pp. 355, illus. U. S. Geological Survey, Washington, D. C.

THE MINING INDUSTRY IN NORTH CAROLINA DURING 1911 and 1912. Joseph Hyde Pratt, State Geologist. 7x10, paper; pp. 342, illus. North Carolina Geological and Economic Survey, Chapel Hill, N. C.

THE CEMENTATION OF IRON AND STEEL. By Federico Giolitti. Translated from the Italian by Joseph W. Richards and Charles A. Rouiller. 6½x9¼, pp. 407, illus.; $4. McGraw-Hill Book Co., New York.

CONTRIBUTIONS TO ECONOMIC GEOLOGY, 1912. (Short Papers and Preliminary Reports.) Part II, Mineral Fuels. By Marius R. Campbell. Pp. 532, illus. Bull. 541, U. S. Geological Survey, Washington, D. C.

THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE. REPORT OF OPERATIONS AND PRODUCTION DURING 1913. By D. H. Newland. Pp. 111. Bull. 580, University of the State of New York, Albany.

JAHRESBERICHT 1913 DES KOENIGLICHEN MATERIAL-PRUEFUNGSAMTES DER TECHNISCHEN HOCHSCHULE ZU BERLIN IN BERLIN-LICHTERFELDE WEST. 7¾x10½, pp. 72, paper. Julius Springer, Berlin, Germany.

CONTRIBUTIONS TO THE STUDY OF THE GEOLOGY AND ORE DEPOSITS OF KALGOORLIE, EAST COOLGARDIE GOLDFIELD. Part II. By F. R. Feldtmann and R. A. Farquharson. Pp. 83, illus., including maps under separate cover. Bull. 51, Geological Survey of Western Australia, Perth.

MANUAL OF HYDRAULIC MINING. T. F. Van Wagenen, 4x6, pp. 123; $1. D. Van Nostrand Co., New York.

A revised edition of this well-known reference book. The work has been brought up to date and a chapter on dredging added. The original plan of avoiding technical terms and explanations has been adhered to, and the language is clear and simple.

MAP OF THE CRYSTAL FALLS DISTRICT MICHIGAN. Compiled by George S. Rollin, Crystal Falls, Mich. 25x32 in., unmounted; $1.

This is a map which will prove most useful to those interested in the district covered where development has been exceedingly vigorous of late. The map shows the mines and the properties under exploration. Mr. Rollin's intimate acquaintance with the district is sufficient warrant for the accuracy of the map.

GYPSUM IN CANADA: ITS OCCURRENCE, EXPLOITATION AND TECHNOLOGY. By L. H. Cole. Pp. 256, illus. Canada Department of Mines, Mines Branch, Ottawa.

This is another of the excellent series of monographs issued by the Canadian Department of Mines, dealing with the occurrence of gypsum, the theories concerning its formation, statistics of the production, including reviews of the Canadian producers, mining methods used, and complete treatises on the methods of working and uses both of gypsum and plaster of paris.

LABORATORY COURSE IN ELECTROCHEMISTRY. By Oliver P. Watts. 5x7½, pp. 145, illus.; $1. McGraw-Hill Book Co., New York.

A carefully designed course of 133 experiments, which covers the general theory of electrochemistry, and its practical applications of electroplating, electroanalysis, electrolytic refining, and electrolytic oxidation and reduction processes. It is difficult to see how any student could perform these experiments and fail to gain a good working knowledge of the subject.

NOTES ON QUANTITATIVE CHEMICAL ANALYSIS. By Charles William Foulk. Third edition. 6x10¼, pp. 250; $2. McGraw-Hill Book Co., New York.

A treatise intended for beginners in quantitative analysis, intended more to teach general principles than specific methods. For this type of book it seems excellent, and for the student taking chemistry as a "required course," or the engineering student studying it as an adjunct to his main course, the presentation seems excellent. It would seem, however, to require supplementing for those going into chemistry as their life work, and it is not in any way a reference book for the practicing chemist.

THE MINING CONGRESS JOURNAL—The first issue of this publication, recently started by the American Mining Congress, has just been issued. Its purpose, as announced by the Congress, will be to keep its members better informed concerning legislative matters, both at the national capital and in the various state legislatures, to carry information concerning important legal decisions and administrative rulings of interest to the mining industry; to carry discussion of the economics of mining and to demonstrate the real relation which exists between mining, agriculture, manufacturing transportation and commerce. Its pages will be devoted to the economic, administrative and commercial rather than to the technical phases of the mining business. Subscription price is $2 a year. Orders may be sent to the American Mining Congress, Munsey Bldg., Washington, D. C.

THE METALLURGY OF THE NON-FERROUS METALS. By William Gowland. 6x8¾, pp. 496, illus.; Charles Griffin & Co., London; J. B. Lippincott Co., Philadelphia, Penn.

The subjects treated are: Refractory materials; roasting, fluxes and slags, copper, lead, gold, silver, platinum, mercury, zinc, cadmium, tin, nickel, cobalt, antimony, arsenic, bismuth, aluminum. There is a vast amount of information in this book in very small space, but it has the disadvantage of the old-fashioned professorial treatise, in that everything is given equal weight, whether it be an obsolete process, or the latest wrinkle in electrolytic refining. However this may not be unmitigated evil, for on reading over these pages, it becomes evident that anyone comprehending the essentials of the old Patera and Kiss processes would understand clearly the Holt-Dern and Knight-Christensen methods of 1914. As a students' textbook and as a cheap substitute for Schnabel there seem to be a wide field of usefulness for this volume.

EXAMINATION OF LUBRICATING OILS. By Thomas B. Stillman. 6x9, pp. 125, illus.; $1.25. Chemical Publishing Co., Easton, Pennsylvania.

Contents: Specific gravity; cold test; viscosity; iodine absorption; flash and fire test; acidity; Maumene's test; color reactions of oils with nitric and sulphuric acids; separation of mineral oil from a vegetable or animal oil; gumming test; sulphur test; test for water; gasoline test; microscopical examination; carbon residue test; fixed carbon in oil; estimation of paraffin in mineral oils; soap test; determination of tarry matters in petroleum products; greases; coefficient of friction; specifications for various lubricating oils; graphite as a lubricant; remarks on lubricating oils; the calorific power of petroleum oils and the relation of density to calorific power; fuel oil specifications; the analysis of lubricating oils containing blown rape-seed and blown cotton-seed oils; the analysis of cylinder deposits; technical examination of petroleum; table of products obtained from Pennsylvania crude petroleum when distilled destructively; and apparatus for the examination and study of the behavior of valve and cylinder oils and other petroleum and lubricating oils in saturated and superheated steam, carbon dioxide, air and other gases.

THE CANADIAN MINING MANUAL, 1914. A Handbook of Information Concerning the Mineral Resources and the Mining Industry of Canada. Edited by Reginald E. Hore. 7x9½ in, pp. 280, illus.; $2. Mines Publishing Co., Toronto, Canada.

The "Canadian Mining Manual" was founded by the late B. T. A. Bell, but the publication was discontinued after his death, no one at that time being willing to take it up. The Mines Publishing Co. has now revived it, under the editorship of R. E. Hore, who is also editor of the "Canadian Mining Journal." A book of this kind can be criticized fairly only after months of use, but it must be said that the first volume of the new issue makes a most creditable appearance. It is a volume of 280 pages, of which 75 are devoted to brief summaries of the chief mineral products of Canada and their history; 60 pages to statements from the Dominion and the various provinces; and the remainder of the book to lists and brief descriptions of the mines and mining companies of Canada. These are arranged by provinces, and are followed by an alphabetical list of companies with references to their products and geographical position. The "Manual" is bound to be useful to anyone interested in Canadian mines. The statistics given are from official sources, and are therefore in marked contrast to those in the old "Manual," whose brilliant editor had a standing feud with statistics and those whose business it was to collect them.

Annual Meeting of the Institute

SYNOPSIS—Brief outline of the sessions devoted to first-aid, non-metallic minerals and general mining; also of the business session and the dinner.

The annual New York meeting of the American Institute of Mining Engineers was held in the Engineering Societies Building, Feb. 15 to 17, inclusive. The meeting began actively at 10 o'clock Monday morning, with a technical session held under the auspices of the committee on safety and sanitation with Arthur Williams in the chair. Four papers were presented and a rather unusual amount of discussion testified to the interest taken in this live subject. The papers were, "Safeguarding the Use of Mining Machinery," by Frank H. Kneeland; "Safety Methods and Organization of United States Coal & Coke Co.," by Howard N. Eavenson; "Housing and Sanitation at Mineville," by S. LeFevre; "Enlarging the Worth of the Worker and the Perspective of the Employer," by J. Parke Channing.

Among others discussing Mr. Kneeland's paper were Doctor Tolman of the American Museum of Safety and B. F. Tillson of the New Jersey Zinc Co.; the latter called attention to the fact that at the Franklin mine, at least, accidents from machinery underground were practically negligible. Mr. Eavenson's paper provoked a rather lengthy and interesting discussion; this was, of course, confined chiefly to coal-mining practice, but Mr. Tillson reported the really excellent results obtained at the Franklin mine by a thoroughgoing safety-first campaign, and received considerable applause. Mr. LeFevre's paper on conditions at Mineville was particularly interesting from the fact that it was illustrated by a series of moving pictures taken at Mineville by the U. S. Bureau of Mines. These pictures interested rather by the charm of familiarity than by that of novelty—to use the phrases of literary critics. Operations of lowering men and material were shown; two miners were seen setting up a two-man piston drill on a tripod and spotting the hole in about 20 sec., which is probably record time—pictures, of course, cannot lie. The rough handling by the cage tender of some miners prone to unsafe practices produced amusement and applause. The preparation of fuses and primers was shown, together with a proper rebuke administered by the foreman to a miner caught tamping his powder with a crowbar—save the mark! As usual the program overran the time allowed to it, and Mr. Channing's paper, in some ways the most interesting of all, from the breadth of its view and the authority of long and successful experience back of it, was presented very briefly and a discussion of it was practically confined to a short talk by Fred H. Rindge. The paper described the work of the Industrial Service branch of the Y. M. C. A., of which Mr. Rindge is secretary. The Industrial Service movement aims to bring together working men and students in schools of engineering to the mutual benefit of both, particularly of the student. Mr. Channing was justifiably enthusiastic as to the aims of the movement, its actual accomplishment and its possible ultimate influence.

On Monday afternoon, there were technical sessions, one by the iron-and-steel division and the other on nonmetallic minerals. At the iron-and-steel session, Albert Sauveur presided and papers were read by title or in abstract as follows: G. K. Burgess and Sir R. A. Hadfield, "Sound Steel Ingots and Rails." F. C. Langenberg and R. G. Webber, "Structure and Hysteresis Loss in Medium-Carbon Steel." W. R. Shimer, "Effect of Finishing Temperatures of Rails on Their Physical Properties and Microstructure." James F. Kemp, "The Mayari Iron-Ore Deposits, Cuba." Walther Mathesius, "High Blast Heats in Mesabi Practice." Henry M. Howe and Arthur G. Levy, "Are the Deformation Lines in Manganese Steel Twins or Slip Bands?" Arthur West, "A Modern Gas-Power Blower Station."

Professor Kemp's paper on the "Mayari Iron-Ore Deposits of Cuba" was illustrated by slides and also by a series of motion pictures. The nonmetallic-mineral session was presided over by C. P. Berkey and Heinrich Ries. Papers by William B. Phillips, Thomas L. Watson and J. Sharshall Grasty, Joseph Hyde Pratt and Edward G. Norton were read by title. Chairman Ries read in abstract

W. L. Saunders

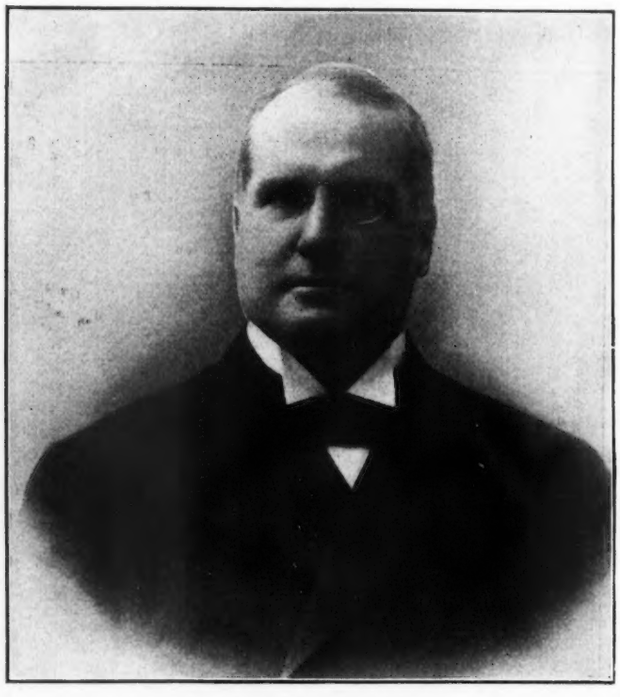
N. B. Davies' paper on "The Plasticity of Clay and Its Relation to Mode of Origin." The papers attracting the most discussion were those of Charles H. MacDowell on "German and Other Sources of Potash Supply," and of Joel H. Watkins on "White Burning Clays of the Southern Appalachian States," in which the possibility of supplanting some of the imported china clays was brought out. The use of a plurality of circular shafts for mining the soft kaolin veins was also an interesting feature to many.

At the business meeting about 1100 votes were cast, which were practically unanimous for W. L. Saunders for president and S. J. Jennings for vice-president. The proposed amendments to the constitution were carried by about 80% of the votes cast.

The report of the membership committee showed a total gain during the year of 1002, making a total of 4958 on Dec. 31, 1914. Among the disbursements, the largest are: *Transactions,* $19,768; *Bulletins,* $16,470; editorial and office, $22,942; principal and interest on mortgage, $30,206. The receipts for the year totaled $118,087.

Synthetic "Crude Oil"

The sensation of the Tuesday afternoon session was reserved till the very end when the chairman, Capt. A. F. Lucas, called upon Dr. Walter O. Snelling, of Pittsburgh, to tell about his experiments in the production of synthetic "crude oil." The afternoon session began with two coal papers; one by Douglas Bunting on "The Limits of Mining Under Heavy Wash" was read by title only; the other, "Recent Developments in Coal Briquetting," was read by Charles T. Malcolmson and showed that coal briquetting was making substantial progress in several sections of this country where economic conditions were favorable.



Sydney J. Jennings

The remainder of the afternoon was devoted to the division of petroleum and gas, and as heretofore this young division of the Institute showed itself an active and sturdy youngster. Lively discussion followed the reading of papers by Prof. Roswell H. Johnson on the "Rôle and Fate of the Connate Water in Oil and Gas Sands"; "Depreciation as Applied to Oil Properties," by Philip W. Henry; "The Use of Mud-Ladened Water in Drilling Wells," by I. N. Knapp. Written discussions of the latter paper included a description by A. Beebe Thompson of a difficult drilling problem in which "heaving" occurred at about 500-ft. depth, due to gas pressure on mud; Mr. Lewis directed attention to some early uses of mud-laden water in drilling in Holland and elsewhere on the Continent. Papers were read by title from Alfred H. Brooks, Howard R. Hughes, S. J. Hardison, M. L. Requa, M. E. Lombardi, F. Julius Fohs and C. W. Washburne. Some slides showing some of the work of the oil-and-gas laboratories of the University of Pittsburgh were presented by Professor Johnson; these showed the oil-gas ratio and the relation of strike to the elongateness of the pools in Pennsylvania and West Virginia.

Chairman Lucas then announced that Doctor Snelling would present the results of his experiments in the production of gasolene from synthetic "crude oil," a development from the result of an abortive experiment made about five years ago. This proved to be the bomb of the session and galvanized the meeting into life at its fag end by the injection of a brand new idea that was not fully accepted by some and brought others to their feet for further information as soon as the speaker finished his announcement. Further details of Doctor Snelling's discovery are given elsewhere in this issue.

Annual Dinner Largely Attended

At the annual dinner at the Hotel Astor on Tuesday evening, there was the largest attendance in the history of the Institute, about 300 members and guests being present. On the front cover of the menu were printed Doctor Raymond's metrical paraphrase of three verses from Job xxviii, 4, 5, 6, and an illustration of a mining operation beneath the "peaceful field." Doctor Raymond's paraphrase, written in 1878, is as follows:

> Above, the peaceful field and fold;
> Beneath, the flame reaps harvest old,
> Whose grain is gems, whose soil is gold.
> He drives his shaft; men come and go
> Above his head, and do not know
> Who swings suspended far below.

At the conclusion of the dinner, Retiring President Thayer reviewed the great success of the past year in the Institute's history, and before closing announced that at a meeting of the board of directors, during the afternoon, Prof. James F. Kemp had been elected an honorary member of the Institute. President-Elect W. L. Saunders then assumed the duties of toastmaster and with characteristic wit introduced the other speakers of the evening, who were: Gano Dunn, president of the United Engineering Society, Job E. Hedges, Dr. Rossiter W. Raymond and John C. Montgomery. Technical sessions were continued on Wednesday, the morning being occupied by the division of nonferrous metallurgy and the afternoon session being devoted to mining and the application of electricity to mining. On Thursday, there were trips to inspect construction work of the Catskill aqueduct and new subways in Greater New York. On Friday, many of the members attended the session of the American Institute of Electrical Engineers at which there was a demonstration of and a discussion of the Cottrell system of electrical precipitation.

Oklahoma's Petroleum Legislation

The New York *Evening Post* reports the passage by the Oklahoma House of a law which prohibits bringing to the surface more oil than can be cared for and sold at a reasonable price. The new law puts the state in control of all Oklahoma's shipments to the market: new wells cannot be drilled except by special permission, storage is limited, and the pipe-line runs from each producer prorated. This is a step far in advance of Oklahoma's previous law, and those of California and Indiana, which touched only methods of drilling and plugging. A re-

markable phase of the matter is that the Interior Department, the state government, and the oil-well owners all conferred upon the proposed legislation, and the great extent of the powers entrusted to the State Conservation Commission represents their agreement.

Gasoline from Synthetic Oil

Perhaps the most startling announcement made at the technical sessions of the American Institute of Mining Engineers in New York, this week, was that of Dr. Walter O. Snelling, of Pittsburgh, who reported to the division of petroleum and gas the results of his experiments in the production of synthetic "crude oil" from various hydrocarbons such as vaseline, rod wax, gas oil, fuel oil, etc. From these hydrocarbons, low in hydrogen, there was repeatedly obtained a synthetic crude oil from which gasoline aggregating from 50 to 70% was distilled after successive reconversions of the residue into synthetic crude oil, the excess carbon separating out as mud. In the conversion of the hydrocarbons into the synthetic crude oil, there is a concurrent production of "natural gas" to the extent of about 2 per cent.

Doctor Snelling's discovery followed an abortive experiment made for a different purpose about five years ago. A vessel partly filled with a heavy oil had been heated to about 450° C. and when opened, was found to contain a product that looked like ordinary crude oil. It was green by reflected light and a rich, red-brown by transmitted light and when subjected to fractional distillation gave about 15% of gasoline. Further examination indicated that it was as similar to crude oil in its constitution as in its appearance.

Difficulty was experienced in attempting to reproduce the conditions to give the accidental result above obtained. However, after considerable experiment, it was found in making the synthetic crude oil that a certain relation between the size of the vessel and the volume of the starting hydrocarbon was necessary. When the vessel was three-quarters full, or one-half full, reaction failed almost wholly, but when the vessel was about three-elevenths full and heated until the pressure gage indicated 800 to 900 lb. per sq.in., the result was invariably a greenish oil containing about 15% of gasoline and other distillates in approximately the same percentages as in crude oil. This result was obtained when starting with vaseline, rod wax, gas oil, fuel oil and presumably other hydrocarbons. A remarkable feature is that the synthetic crude oil can be repeatedly distilled and reconverted so that first 18% of gasoline, then 15%, then 12%, etc., are successively obtained until 50 to 70% of the original hydrocarbon was obtained as gasoline of about 70° Bé. When starting with paraffin, the eventual yield was 70% of water-white gasoline and about 30% of natural gas.

Doctor Snelling concluded from his experiments that when a hydrocarbon body occupying more than one-tenth and less than one-half of a vessel is heated to a pressure of 800 to 900 lb., a fundamental change occurs; the hydrogen and carbon atoms seem free to rearrange themselves and form a more or less definite mixture of hydrocarbons in appearance and constitution not unlike crude oil. There is a residual pressure of about 150 lb. in the vessel after cooling, due to the formation of about 2% of natural gas. Doctor Snelling suggested that natural crude petroleum might in some instances have been produced by nature by some process related to his experiment, perhaps by lower temperatures acting through geologic agents; also that the natural gas associated with petroleum might have a related origin analogous to that invariably produced with the crude oil by his process. Time has practically no effect on the reaction, which is fairly quick under these conditions; at least, the reaction was complete in vessels that were quenched in water as soon as the gage reached 800 lb. Questioned as to the percentage of coke left in the vessel, Doctor Snelling said there was practically none, but that there was a pasty mass of separated carbon insoluble in the menstruum. The synthetic crude oil formed contains proportionately more hydrogen than the heavier oils, and as the latter were already deficient in hydrogen, much of the carbon finds no hydrogen to combine with and hence separates out as "mud."

The gasoline distilled from the synthetic crude oil is normal in color, but different in odor, though nothing like that of the "cracked" volatile products. The odor of the Snelling synthetic crude oil and of all the distilled products thereof is milder and sweeter than that of natural petroleum and its products. Doctor Snelling exhibited to the members of the Institute samples of a yellow lubricating oil and the products made therefrom which, in appearance, resembled crude oil and its distillates, but were all much milder in odor. The gasoline produced is reported to be suitable as motor spirit and other customary uses of normal gasoline. The Snelling gasoline is water-white in color and notwithstanding that some of it has stood over one year and has never been treated with acid or alkali, it had not changed color nor altered in any other respect during this period. Complete tests have not been made of the various products.

While the process has not yet been developed to definite conclusions as to many points, Doctor Snelling announced that through the interest of a well known mining man, John T. Milliken, of St. Louis, further research had been made possible, and that commercial experiments had now been undertaken by the Milliken Refining Co., of St. Louis, at its refinery at Vinita, Oklahoma.

The Copper Seizures

The New York *World* recently published the allegations of the copper producers as filed with the Department of State. Among the more interesting statements are the following:

That since the outbreak of the war, and up to Jan. 1, 1915, thirty-one shipments of copper from the United States to neutral Continental ports have been seized by Great Britain. These seizures aggregate 19,350 tons, of which this amount 9350 tons are piled up at Gibraltar alone. Four of the shipments were destined for Holland, 14 for Italy and 13 for Sweden.

American owners consented to sell four small lots to the British Government at a loss rather than undergo the expense and delay of prize court proceedings. On these four shipments the British Government, the shippers declare, caused the Americans and their insurance brokers to divide a loss of $30,000 by forcing the sales at a price far below that offered by the original consignees.

That a small group of British agents have seized and are dominating all America's foreign markets under the regulations laid down for the movement of copper by the British Government, forcing the United States to sell through these agents. This group of half a dozen men is levying a 1% toll upon every ton of copper exported from the United States.

In addition to the commission, British agents are taking a warehouse toll of $1.10 a ton on all copper embargoed by Great Britain.

One of the largest concerns involved—the United Metals Selling Company—is transacting business with neutral countries freely through Charles S. Henry & Co., while unable to make a single sale direct.

A representative of Henry R. Merton & Co., the largest dealers in metals in England, came to New York about Dec. 15 and proposed to the large copper concerns that they pool all their trade, agree to sell only through Merton & Co., and Merton & Co. would guarantee delivery of all cargoes, avoiding troubles due to the British Admiralty's stringent regulations. The proposition was declined by the United States copper interests on the ground that Britain's contraband regulations should not be used to deliver America's entire export trade into the control of English merchants.

On Jan. 1 a director of Merton & Co. cabled the American Smelting and Refining Company, the United Metals Selling Company and the American Metal Company as follows:

Referring your Government's protest, I renew my proposals to you, which will obviate practically all your difficulties. Am ready take reasonable care your agents.

This proposition was briefly and firmly declined, the American concerns maintaining their right to do business without Merton & Co.'s permission.

Two weeks later Merton & Co. cabled:

Have signed explicit agreement British Admiralty; file with it certified copy of every contract by or through us for shipments American houses.

New Publication on the Smoke Problem

With the idea of bringing about a better understanding between the metallurgical industry and agriculture as to the troublesome smoke problem at smelting and ore-roasting plants, the United States Bureau of Mines has just issued Bulletin 84, "Metallurgical Smoke," by Charles H. Fulton, consulting metallurgist.

The problem of smoke control is peculiarly difficult in this country because of the large tonnages of material that must be handled. The solution is not yet at hand and much work remains to be done. As the mineral industry is one of the great basic industries of the country, it should be accorded freedom to work out the smoke problem to the greatest benefit of all concerned. The effort is made in this paper to present the problem of metallurgical smoke as it actually exists, without bias of any kind.

The author says: "It is evident that the solution of the problem lies in its study by disinterested commissions, such as the one recently appointed by an agreement between the Department of Justice and the attorneys of the Anaconda company to study the smoke question in Montana in its relation to the forest reserves.

"It is interesting to review the general situation in this country. Mining and metallurgy are often the advance agents of civilization and the pioneers in establishing industrial centers. In many localities the miners and the smelters supplied by them were essentially the only locators within great stretches of territory. Around them grew communities and cities dependent upon them for a livelihood. Agriculture was of relatively small importance. But conditions changed with the increasing population of the country and the closer settlement of the West and, coincident with this increase, an agricultural industry has grown which, in the vicinity of the smelting plants, naturally suffers in some degree from smoke. Still, the area damaged is comparatively small and even this damage can be much lessened by the adoption of proper means. Since some plants have installed devices to remove sulphuric acid from the smelting smoke and have the smoke diluted with air, conditions have been much ameliorated.

"It has been customary to discharge the smelter smoke by means of very tall chimneys, on the assumption that if the noxious gases are discharged at considerable height they will have opportunity to diffuse more thoroughly and thus become so diluted as to be comparatively harmless, but the efficiency of this method is now being questioned. There is reason to believe that the use of high stacks increases the area to damage, whereas low stacks may intensify the damage but concentrate it within a smaller area."

Copies of Bulletin 84 may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

Mine-Rescue Stations and Cars

The U. S. Bureau of Mines announces the following assignment of its rescue cars and stations with the personnel of each:

Car or Station No.	Headquarters	Engineer in Charge	Foreman Miner	First-Aid Miner
Sta. 1	Wilkes-Barre, Penn.		(See Car 1)	
Sta. 2	Pittsburgh, Penn.	J. W. Paul	W. J. German	
Sta. 3	Knoxville, Tenn.	E. B. Sutton	J. M. Webb	
Sta. 4	Birmingham, Ala.	E. B. Sutton	W. T. Burgess	
Sta. 5	Urbana, Ill.	H. I. Smith		
Sta. 6	McAlester, Okla.	J. J. Rutledge	J. W. Koster	
Sta. 7	Seattle, Wash.	H. M. Wolffin	J. J. Corey	
Sta. 8	San Francisco, Calif.	H. M. Wolffin	E. Steidle	A. A. Krogdahl
Sta. 9	Pittsburg, Kan.		K. H. Chisholm	W. W. Fleming
Car 1	Wilkes-Barre, Penn.	Charles Enzian	Jesse Henson	
Car 2	Denver, Colo.	J. C. Roberts	G. W. Riggs	C. S. Arthur
Car 3	Evansville, Ind.	H. I. Smith	G. T. Powell	*J. R. Fleming
Car 4	Pittsburg, Kan.	J. J. Rutledge	A. I. Young	J. H. East
Car 5	Billings, Mont.	J. C. Roberts	John Beardman	
Car 6	Pittsburgh, Penn.	J. W. Paul	C. O. Roberts	G. W. Grove
Car 7	Ironwood, Mich.	Edwin Higgins	W. W. Sullivan	
Car 8	Huntington, W. Va.	D. J. Parker Dr. W. A. Lynott	H. D. Jones	R. H. Seip

Note—Auto truck No. 1 attached to station 2 with C. O. Roberts as foreman miner and auto truck No. 1 attached to station 4. *Permissible demonstrations.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALLOY—Iron, Boron, Carbon, and Copper Alloy. Edward D. Gleason, New York, N. Y., assignor, by mesne assignments, to Neu-Metals & Process Co., Long Island City, N. Y. (U. S. No. 1,126,629; Jan. 26. 1915.)

BLENDE—Process of Treating Ores. Joseph W. Emerson, Salida, Colo. (U. S. No. 1,126,965; Feb. 2, 1915.)

CLASSIFIER—Ore Classifier and Concentrator. Charles O. Michaelson, Omaha, Neb. (U. S. No. 1,126,819; Feb. 2, 1915.)

CONCENTRATOR — Mineral Concentrator. Charles O. Michaelsen, Omaha, Neb. (U. S. No. 1,126,818; Feb. 2, 1915.)

COPPER and Process of Producing the Same. William Marshall Page, Philadelphia, and Wirt Tassin, Chester, Penn., assignors to The Duplex Metals Co., New York, N. Y. (U. S. No. 1,125,164; Jan. 19, 1915.)

COPPER-CLAD STEEL—Clad Metal and Process of Producing the Same. William Marshall Page, Ridley Park, and Wirt Tassin, Chester, Penn. (U. S. Nos. 1,125,160 and 1,125,161; Jan. 19, 1915.)

CRUSHER. Albert E. Smith and Charles G. Simonds, Milwaukee, Wis. (U. S. No. 1,127,101; Feb. 2 1915.)

CRUSHING—Process of Wet Grinding. Henrik Emil Riisage, Frederiksberg, Denmark, assignor to F. L. Smidth & Co., New York, N. Y. (U. S. No. 1,126,085; Jan. 26, 1915.)

DRILL—Fluid-Operated Percussive Tool. Lewis C. Bayles, Easton, Penn., assignor to Ingersoll-Rand Co., Jersey City, N. J. (U. S. Nos. 1,126,943 and 1,126,944; Feb. 2, 1915.)

DRILLING—Walking Beam for Drilling Apparatus. George H. Copeland, Rich Hill, Mo. (U. S. No. 1,122,255; Dec. 29, 1914.)

DRILLING MACHINE. Albert Hossfeld, Lewiston, Minn. (U. S. No. 1,127,003; Feb. 2. 1915.)

DRILLS—Valve for Percussive Tools. Lewis C. Bayles, Easton, Penn., assignor to Ingersoll-Rand Co., Jersey City, N. J. (U. S. No. 1,126,940; Feb. 2, 1915.)

ELECTRIC FURNACE. James G. Marshall, Niagara Falls, N. Y., assignor to Union Carbide Co., Niagara Falls, N. Y. (U. S. No. 1,127,475; Feb. 9, 1915.)

FLOTATION—Ore-Flotation Apparatus. John M. Callow, Salt Lake City, Utah, assignor to Metals Recovery Co., Augusta, Me. (U. S. No. 1,124,856; Jan. 12, 1915.)

FURNACE-BELL HOIST. Thomas E. Brown, New York, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. (U. S. No. 1,127,351; Feb. 2, 1915.)

FURNACE HOIST. David Larson, Berlin, Germany, assignor to Otis Elevator Co., Jersey City, N. J. (U. S. No. 1,127,364; Feb. 2, 1915.)

Editorials

What May Happen to Spelter

That the recent rise in the price of spelter to a figure previously unheard of in the memory of a generation is an industrial calamity, most good judges are agreed. There is disagreement as to whether the rise has yet culminated. Some think that the price will go still higher. Others are of the opinion that the climax has been reached and that a declining tendency will exhibit itself in April or May. One man's guess is as good as another's. Conditions are extraordinarily confused, and no man is wise enough to weigh and measure them. Prophecies as to the course of the market are idle. However, there are certain coming events that may be foreseen with some clearness.

Production in the United States is going to be increased materially. In 1914, about 360,000 tons of spelter were produced in 22 works using about 83% of their capacity. Old works if operated at full capacity were consequently able to produce about 56,000 tons more of spelter than in 1914. In addition thereto there was new plant of 17,500 tons capacity (terms of tons of spelter) immediately available, and furnaces of nearly 11,500 tons capacity in construction and so far advanced as to become available early in 1915. There were also two inactive plants possessing a capacity of about 10,000 tons. We do not include the moribund works of Kansas, which may or may not be put into use. They had a capacity of about 62,000 tons. Stocking them with ore at present prices would be a hazardous venture, which conservative interests have not yet shown any disposition to risk.

The United States possesses therefore, or very soon will possess, first-class capacity for the production of 445,000 tons of spelter per annum; and second-class capacity amounting to 72,000 tons additional that may be used in emergency. These figures take no account of the dross and scrap smelters.

The estimate of a maximum capacity for 517,000 tons of spelter must be discounted, however, being based on the average yield in a year of low price when the ore treated was doubtless of a relatively high grade. The high price for spelter will draw out lower-grade ore and the average yield per retort will be lower. Moreover, the roasting capacity of American smelters is materially short of their distillation capacity, which means that they may not be able to attain the maximum use of their distillation furnaces unless they can secure all the calamine ore that they need, and calamine ore is generally of lower grade than blende. It is best not to undertake to draw fine points, but simply to assume that the smelting capacity of the United States is largely in excess of any use of it previous to the end of 1914.

That there will be sufficient ore supply for a largely increased capacity is reasonably certain. We learned in 1914 that a tremendous ore supply was available even on the basis of 5c. for spelter. The present prices will force production everywhere.

The New Jersey willemite that used to be exported to Belgium and Germany is of course now being smelted in this country. If we are unable to obtain sufficient calamine from our own sources, we may import it from Sardinia and elsewhere. Blende will doubtless be brought hither from Broken Hill.

The last may be a potent factor. A deterrent influence upon expansion is the great risk that a smelter incurs in laying in a stock of ore at the present level of price. The going concerns are running big risks and are exacting larger smelting margins, but the chances are worse for a beginner. The owners of certain of the idle plants have sought vainly to borrow the money needed to buy ore; the owners of others have restrained all temptations to resume. This situation would be quite different, of course, if some big mining company, like one of the Australian companies should lease these works or should supply the smelters with ore and guarantee them against loss.

Another certainty is that the high price for spelter will restrict consumption. In this respect, spelter is more vulnerable than almost any other metal.

Upward of 50% of the domestic consumption of spelter is for galvanizing, which, after all, is a more or less unnecessary use. Pipe is galvanized because it looks better and is cleaner than black pipe for interior use. The galvanizing of barbed wire affords a certain protection against the weather, but not a protection that is long or sure. As a structural material, there are many engineers who prefer painted black sheets to galvanized sheets, regardless of price, but when the premium for galvanized sheets becomes excessive, most people discontinue using them and content themselves with black sheets.

Increased production and diminished consumption are therefore two sure developments of the excessive price for spelter, and they will eventually bring about a collapse of the price. We shall then find ourselves with a greater surplus of producing capacity than ever and shall experience the long depression in this business that has invariably followed a period of intoxication when the price for spelter has been above 7c. per lb.

Why Does Firebrick Cut Out?

Why does firebrick cut out when it is employed to contain molten slag? The answer is immediately that it scorifies with the acids of the slag, wherefore a siliceous brick should be used with a highly siliceous slag and a more basic brick with a less siliceous slag, etc. These are classic precepts of metallurgy and they seem to have been borne out by experience. Anyway, everybody knows that a brick-lined lead or copper blast furnace does not last long, while the lining of a combustion chamber that is merely heated and is not exposed to slagging may last a long time. Thus, certain of the distillation furnaces at Cherryvale, Kan., have lately been relined after a campaign of eight years. The temperature in those furnaces must have been 1300° to 1400° C.

The linings of the tanks of reverberatory smelting furnaces last for a fairly long time; at least the tanks do. Investigations with a sounding rod often reveal unex-

pected depths and excite the idea that the furnace may be simply a roof over a pool of molten matte standing in the earth with not much lining remaining up to the zone of natural chilling. The iron smelter continues to run his huge blast furnaces without the aid of water jackets.

The contempt of the lead and copper smelter for anything that is not water-jacketed has often caused wonder among other technologists who habitually perform fusions in clay vessels. Thus, the old-time glass-makers regularly melted easily fused glasses, or slags, in simple pots, and those who do not have tank furnaces still do so. The zinc smelter uses a clay retort only 1 in. thick, which rests in the furnace like a beam supported only at the two ends and is exposed to a temperature as high as 1550° C. He tries to keep the slag away from the walls, but sometimes is unable to do so.

C. W. Berry, in a recent paper in the "Transactions of the American Ceramic Society," says that the resistance of the firebrick of glass tank furnaces and of the pots of older practice to the action of fluxes depends more upon the physical structure of the firebrick than upon its chemical composition. The brick or clay should be of such density as to prevent the penetration of fluxes. Brick high in silica and brick high in alumina are both quickly destroyed if they be not sufficiently dense, while the addition of silica in order to obtain what is conceived to be chemically a desirable composition is inadvisable, inasmuch as it increases porosity. This is on the line of what every furnaceman knows, viz., that the eating of a firebrick lining begins at the joints. Therefore, he aims to lay his brick with the thinnest possible joints, even grinding the brick together in the most refined masonry. The porosity of the brick itself is not so often considered, but it is something well recognized by the zinc smelter, who aims to make the densest possible retort in order to reduce seepage of zinc vapor through it.

Muckraker and Magnate

The United States Industrial Commission has come and gone, in so far as New York is concerned. What it learned here may not be of great use in its deliberations, but there was here a great opportunity for the stage manager, of which full advantage was taken. The appearance of a noteworthy succession of magnates on the stand, culminating in the great double bill with John D. Rockefeller and Andrew Carnegie, commanded front-page space for a fortnight and enabled the commission to depart with feelings of dramatic satisfaction if not of enlightenment.

We had a few surprising exhibitions, none of which was more interesting than the contrast between the views of Miss Ida Tarbell and Daniel Guggenheim. The former was one of the earliest of the muck-rakers; the latter is one of the most eminent of the great corporation magnates. We might reasonably have expected Miss Tarbell to rant and Mr. Guggenheim to uphold the old order of things. But not so. Mr. Guggenheim figured as an exponent of the uplift, while Miss Tarbell was the heartless economist, the scientific dissector of causes and effects, the abolisher of sentiment. Listen to Miss Tarbell:

"Does efficiency preclude the idea of democracy in the management of industry?"

"It is the most democratic thing you can think of. The man in overalls goes right to the office and complains. If you ask if it precludes the idea of union organization I say that it does not. I think the unions are doing wrong in not going into the shops and learning all about it. To say at the start that it can't be done is wrong."

"Do you consider the union essential to the protection of the workmen where there is scientific management?"

"No; it is not essential. The managers who understand the inevitable reaction of injustice to their workmen wouldn't impose upon them any more than the union would."

"Why are the labor unions opposed to scientific management?"

"The testimony before this commission would indicate that one of the reasons is that they know so little about it and don't want to learn. Of course that is a very bad policy on the part of the unions."

"Hasn't the union a right to be shown that this scientific management is a good thing for the workingman?"

"Certainly. The trouble is that the unions are not trying hard enough to be shown."

"Miss Tarbell, isn't the safety expert and the efficiency agent a form of despotism that is being established over the workingman?"

"No. If he were, then the school teacher is the best known despot in this country. The worst despot I ever met was the woman who instructed me in calculus."

"Wouldn't the general installation of the efficiency system restore to the employer that despotism which he possessed before the labor unions took it away from him?"

"Not for a moment."

"Do you believe that the unions oppose scientific management because they fear an increase in production?"

"Yes. The fear of abundant production is very great. Union men have been trained to that idea in order to keep the price of labor high. The great trusts have the same idea with respect to prices of their commodities. There is an idea that keeping down production means prosperity, and it is natural for the workman to think that he should keep down his product so as to increase wages. I believe that work makes work, that you should get out as much as you can. The fear of abundance is a most pernicious thing. The worker must revise his ideas."

This is all sound sense and sound economics. Mr. Guggenheim was not so sound in his economics when he preached the reduction of great fortunes by inheritance taxes. Mr. Guggenheim did not express himself about labor unions, but he was earnest in his sympathy for the laboring men and radical in his ideas of what should be done to improve their lot. Indeed, the socialists present at the meeting were unable to disguise their astonishment and remarked that Mr. Guggenheim was outstripping them. However, his ideas reflected a kindness of heart that disarms criticism.

The apex litigation at Tonopah, Nev., involves several points in connection with the mineral law and the troubles and questions of the apex and extralateral rights that have not heretofore been construed by the Supreme Court of the United States, wherefore the cases will probably have to be taken there before they are ended. The conditions of the mineral deposits of Tonopah are exceedingly complicated anyhow. This is one more example that the only safety from litigation under our present archaic and impracticable mineral-land law is the abolition of that law by common consent as has been done in many of our important mining districts. Everybody interested in the mining industry should unite in a grand effort to have a revision of the mineral laws.

There has been a slight increase in the production of copper, which seems to be fully warranted by the present demand. There does not appear to be, however, the least indication that any of the large producers meditates cutting loose and expanding production to the rate of the middle of 1914. All seem to prefer to produce according to the demand and get 14@14½c. rather than to overproduce and take a less price.

BY THE WAY

Some of the difficulties now attending the formal proceedings of certain mining companies were illustrated at a recent meeting of the debenture shareholders of the Tanganyika Concessions. The meeting, held in London, had only the status of an informal gathering, because the trustees had been able to get no notice published in a newspaper in Brussels, and because, owing to the unavoidable absence of the Belgian shareholders, there was not a quorum present. The object of the meeting was to obtain the consent of the debenture holders to foregoing their interest until the present war is over. Among the debenture holders present, the sentiment was overwhelming in favor of carrying out the recommendations of the trustees.

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To supplement the "By the Way" of Feb. 13, there is a little story vouched for as true by a French mining engineer. In 1890-95, when mining had become quite active in the Amoor country, five or six prospectors strayed over into China—or Mongolia—and finally located some rich placer ground on a tributary of the Amoor, about 50 miles south of that river and 80 miles from Blagoviestchenk, the chief Russian town in that region. To them were gradually attracted others, until a community of 250 people, or thereabouts, had collected. They were a queer mixture of Russians, Tungoose, Mongolians and Chinese, but they got along pretty well together; under the leadership of two Russian escaped convicts they organized themselves into what they called the "Free Mining Republic" and enacted a mining law which served them well enough. Their prosperity at last came to the ears of the Chinese governor, who sent a military expedition to establish Chinese supremacy and collect taxes. The expedition, however, found conditions so much to their liking that it disbanded promptly and the whole force—mandarin, officers, soldiers and all—went to placer mining. A second expedition sent to hunt up the first speedily followed its example. The "Free Mining Republic" subsisted until the Russian governor of the Amoor province sent a force down there—nominally in coöperation with the Chinese governor of Mongolia—and scattered the people. Very few were brought back to Blagoviestchenk, most of them escaping southward into Mongolia.

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The New York "Sun" of January 17 prints a story from Fairbanks, Alaska, showing what an Alaskan miner can do when he has to. We assume that the story is correct; although somewhat wildly told in the newspaper, there is no reason it should not be true. It appears that Manley Mayhood and John Parquette were operating a drift mine as partners. Early one afternoon, just as darkness was falling, Parquette heard a crash in the shaft and rushed out to find that his partner and the bucket had fallen down together. The shaft was 45 ft. deep. Parquette tried to climb up a rope, but it slipped off the sheave and let him down again. He tried it with another rope, but this uncoiled from the drum. The shaft was lined with glare ice several inches thick. Parquette began shouting, but the shaft was off the main road and he was not heard. He saw he would have to adopt some desperate measure. First he went to the end of the workings where the steam points had left quantities of warm earth, brought this back, and packed it around his unconscious partner, after having wrapped him in his jumper and overshirt. Later he changed this as it became cold. A ½-in. steam pipe ran up one corner of the shaft, but he decided it wouldn't hold him, so he brought up from the drift a 1-in. board which he had been using as a wheelbarrow runway. He took everything heavy out of his pockets but left on his shoes so as to get a better foothold. At a point about halfway up the shaft narrowed from 12 ft. across to 8 ft. He climbed up to this point by cutting notches in the ice over the timbers with his knife, and then descended and carried up one of the steam points. He inserted one end of this in the hitch and let the other catch against the other side of the shaft. With the other point he repeated the operation. Meanwhile his candles were getting short. Using the steam points this way Parquette finally, after hours of hard labor and freezing cold, won the top of the shaft. He got to a roadhouse about half a mile away, and started a rescue party back to Manley, whose life, from last accounts, was hanging in the balance. Parquette, himself, escaped uninjured.

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The Shaftman

By Berton Braley

He's up and down on the cage all day
With his oil-light flaming high,
And he works in a shower of falling spray
For it's seldom a shaft is dry,
But with yellow slicker and yellow hat
He's snug as a bug inside,
While he watches the timbers like a cat
For a crack in a plate or guide.

It is up to him, and there's no excuse
If a cage and its burden spill
When a wallplate springs or a guide works loose
And the splinters smash and kill,
So you bet he is right on the job for fair
Alert for each bulge or cave,
For every hour of his shift he's there
Making that shaft behave!

The copper water will drip and drip
And it's up to his nibs to see
That the cable which carries the cage and skips
Is tarred as it ought to be
For that water gnaws at the naked steel
And the miners' lives must hang
On the cable's strength and the loyal zeal
And faith of the shaftman's gang.

No, it isn't the gates or the safety clutch
That guard you in the shaft,
Mechanical aids don't count for much
Except for the skill and craft
Of the boy who toils in the wet and murk
Watching for bulge or cave,
And always doing his daily work
Of making that shaft behave!

PERSONALS

James MacNaughton, general manager of Calumet & Hecla, has returned to Calumet, Mich., after a visit to Boston.

Allan B. Calhoun recently changed his address from Frisco, Ariz., to 714 Mills Building, El Paso, Texas, care of the Mines Co. of America.

T. McCampbell, of New York, who is connected with the Harriman interests, has been inspecting Porcupine, Ont., properties with a view to investment.

Allan Strale has resigned as chief engineer of H. Koppers Co., of Chicago. Mr. Strale will be succeeded by W. F. Rust, now general superintendent of the Otis Steel Co., Cleveland.

W. A. Locke, who retired Feb. 1 from the presidency of the American Manganese Bronze Co., is now associated with the Taunton-New Bedford Copper Co., with office in New York.

R. M. Edwards, general manager of the Franklin, South Lake, North Lake and Indiana properties, has returned to Boston after a visit to the mines in the Lake Superior copper country.

Walter Whilton, for some time past connected with the Carnegie Steel Co., has been appointed superintendent of the new steel works of the Broken Hill Proprietary Co. in Australia.

Prof. A. P. Coleman has returned to Toronto, Ont., from a trip round the world, during which he narrowly escaped being captured by the German war ship "Emden," when traveling near the Straits Settlements.

J. J. Hasbrouck, formerly with the Cananea Consolidated Copper Co., has been appointed engineer of the Peruvian Expedition, which will start from New York, Feb. 24, under the joint auspices of Yale University and the National Geographic Society.

Wilfred Bancroft, treasurer and secretary of Mass Consolidated, has returned to Boston from Michigan after a week at the mine. He addressed a gathering of Mass, Greenland and Ontonagon business men and spoke optimistically of future of mine.

R. B. Oliver, engineer in charge of the Kasai diamond fields of the Société Internationale Forestière et Minière du Congo, has arrived in the United States and has gone to visit at his home in San Francisco. He will remain in this country until August or September.

H. M. Wilson of the U. S. Bureau of Mines is in San Francisco in the interest of the bureau exhibit in the Panama-Pacific Exposition. The model mine installed in the Mines and Metallurgy Building, while under direct superintendency of Edward Steidle, will be under the general supervision of Mr. Wilson.

Ralph Arnold, geologist and petroleum expert engineer, was elected to the board of trustees of Stanford University, Jan. 29. Mr. Arnold graduated from Stanford with the class of 1899. He is the second member of the alumni to be elected trustee, H. C. Hoover being the first. Mr. Arnold served as assistant in the mineralogy department of the University and also assistant in geology following his graduation. He became prominent in the California petroleum field as a field assistant of the U. S. Geological Survey, and later was geologist of the department. Mr. Arnold also has done private work for oil companies in Mexico and South America, maintaining offices in Los Angeles and New York. He is now consulting engineer of the City of Los Angeles.

OBITUARY

John Vivian, 60 years a resident of Lake Superior copper district, and a pioneer Cornish miner, died at Calumet, Mich., last week. His father was copper superintendent for John Henry Vivian, father of Lord Swanzey. John Vivian came from Cornwall to America and first worked at Greenwich mine in Connecticut, later at lead mines at Ellenville, N. Y. He had worked at Cliff mine in the Lake Superior country in 1854.

Livingston Gilson, one of the oldest mining engineers of the Pacific Coast, died in February at San Francisco. He was born at Reading, Penn., in 1831, and went to California in 1852. He was engaged for many years in developing and managing large producing mines in the southern districts of the Mother Lode region, chiefly in Tuolumne County. In 1870 he and Henry Janin had offices in San Francisco. Gilson went to London in 1896 as consulting engineer of the London Exploration Co. He was in Paris when the European War started and after suffering much hardship reached London and then returned to California. He leaves a widow.

SOCIETIES

Western Ontario Clay Workers' Association—At the annual meeting at Chatham, Ont., Feb. 11, the following officers were elected: President, Walter Clark, Sarnia; first vice-president, David Martin, Thamesville; second vice-president, R. W. Leatherdale, Dresden; secretary-treasurer, Alfred Wehlann, Cairo.

Mackay School of Mines, at Reno, Nev., is giving first short course for prospectors, beginning Feb. 1 and lasting four weeks. Course includes lectures on excavation of earth and rock, prospecting, geology, assaying and mining law; laboratory work in mineralogy, gas engines and first aid to injured.

Colorado School of Mines—First annual short course for practical prospectors began at Golden, Feb. 8, with an enrollment of 43. Ages of these students vary from 22 to 77 years. Only elementary subjects will be presented, the instruction being intended only to fit men to more intelligently search for and identify minerals of commercial importance.

University of California—Whitman Symmes, superintendent of the Mexican and Union Consolidated mines on the Comstock, recently delivered a course of five lectures for the senior class of the mining school. The subjects were the geology of the Comstock lode; mining methods; mine timbering; mining and pumping machinery on the Comstock; metallurgy of the Comstock.

The Colorado Scientific Society held its regular monthly meeting Feb. 6, at the State Museum Building in Denver. Dr. Livingston Farrand, president of the University of Colorado, delivered an instructive lecture on the American Indian, to a large and appreciative audience. Dr. Farrand discoursed upon the geographical distribution of the Indian, the theories in connection with migration and origin, and the Indian languages.

Colorado University Scientific Society—Dr. O. C. Lester, professor of physics in the university, on Feb. 8, at Boulder, addressed the society on the distribution of radium in the state. Accompanied by John H. Finney, an instructor in his department, he toured the state last summer in the interest of the Colorado Geological Survey, making field tests of every bubbling spring that was found. He reports orally that radioactivity was almost invariably evidenced, in some instances very pronounced. His detailed report will be published later and will be for free distribution.

The Teknik Klub of Denver, a society composed of metallurgists, mining engineers and chemists, its membership limited to 50, with a good waiting list, at its monthly banquet on Feb. 9, listened to and discussed two papers. One was "Technical Phases of Insurance," by A. R. Schroeder. The other paper was "Methods and Difficulties in Sampling Lots of Ore," by Walter E. Burlingame. The club has made arrangements whereby its founder, Dr. Lucien I. Blake, of Boston, will deliver a series of lectures, on succeeding Monday evenings beginning Mar. 1. These ten lectures may be said to cover the broad subject of Cosmic Physics. It is quite probable that Dr. Blake, during his visit to Denver, will deliver a distinct series of lectures before the upper classes of the Colorado School of Mines.

American Institute of Mining Engineers—On the evening of Feb. 5 the Montana Section held its semi-annual meeting at the Silver Bow Club in Butte. After an informal dinner officers were elected for the ensuing year as follows. Frank M. Smith, manager of the East Helena smelter, chairman; J. L. Bruce, manager of the Butte & Superior Co., vice-chairman; D. C. Bard, secretary and treasurer; Frederick Laist of Anaconda and W. C. Siderfin of Butte, members in charge of the local affairs of the society. Theodore Simons of Butte then read a paper on the "Concentrator of the Timber Butte Milling Co.," illustrated by flotation experiments on a laboratory scale and by a large flow sheet. Paul Billingsley followed with a paper entitled "The Boulder Batholith." About 60 members were present.

The next meeting of the Utah Section will be held at Salt Lake City, Feb. 25, at the Alta Club, to be followed by a business meeting and discussion of the program for the ensuing year.

Editorial Correspondence

SAN FRANCISCO—Feb. 10

Heavy Storms prevailed over the state the latter part of January and the first part of February. There have been numerous floods in the rivers, but no large amount of damage reported, owing to the fact that the river levees have been improved in the past year and much of the land saved from overflow. The rain in the valleys and lower elevations has been accompanied by snow in the higher elevations. The indications at present are that there will be an abundant supply of water for mining purposes during the season. The amount of snow in the higher mountains has apparently been sufficient to withstand any ordinary melting by change to warmer weather. In fact, the entire outlook for mining water in the coming season is favorable.

North End Comstock conditions are graphically represented in a chart prepared by Whitman Symmes. There are shown the relative positions of the mines, the area unwatered since 1898 and the ore produced from the cleared area, both tonnage and value. The chart shows that the Con. Virginia, Ophir and Mexican have produced from the drained area $7,000,000. This encourages the belief that deep mining at the north end of the Comstock will prove profitable. The chart also shows that for every share of capital stock the yield in bullion has been: Con. Virginia, $7; Ophir, $20; Mexican, $6.50, since the unwatering was begun. These returns are from ground supposed to have been prospected by former managements of the mines.

The Yellow Jacket annual stockholders' meeting was held on Jan. 27 in San Francisco. The reëlection of the entire retiring board of directors was unanimous. The directors are Edward B. Sturges, Geo. S. Sturges, Edward S. Spring, Chas. H. Sooy and Dwight S. Prentice. Edward B. Sturges was reëlected president; George S. Sturges, vice-president, general manager and agent of the company in Nevada; Edward S. Sturges second vice-president and secretary; R. B. Worthington and Dwight S. Prentice, assistant secretaries; Chas. H. Sooy, general counsel. It has been decided, if the Belcher and Crown Point agree, to transfer the operations for working the 1500- and 1600-ft. levels of the three mines to the Yellow Jacket incline, which is being put in good order down to the 1500-ft. station; the Yellow Jacket will reopen the 1500-ft. level for regular extraction from the west quartz orebody on that level. While this work is in progress Crown Point and Belcher joint-incline reopening and repair work are going ahead, having reached below the 1450-ft. point where the recent fire occurred. Additional pumping and hoisting equipment is to be installed.

Southern Pacific Land to the extent of 6000 acres held as agricultural in San Bernardino County, has been awarded to the Government in a contest in the local land office at Los Angeles, on the ground that it is mineral in character. The land is situated northwest of Needles and west of the Colorado River in a mineral region well known but undeveloped. There are several mineral districts in this region along the eastern edge of the county where some promising prospects have been discovered. But as in most of the desert region, development is slow unless exceptional finds of high-grade ore in large bodies are disclosed. The Santa Fé and the San Pedro, Los Angeles & Salt Lake roads have opened up a good deal of this region and made possible the profitable development of mineral lands that for years were considered of small value for either mining or agriculture. The contested land contains proved deposits of gold, silver and copper. The Southern Pacific will appeal to the General Land Office.

In the Mines and Metallurgy building at the Panama-Pacific Exposition the chief features of the exhibit will include a model mine installed by the U. S. Bureau of Mines; the steel and iron exhibits of the U. S. Steel Corporation; the petroleum exhibit by the governing boards of the states and counties producing petroleum in the United States and others interested in the industry; an exhibit by the California State Mining Bureau, which will include a part of the bureau museum; and exhibits by counties or mine owners. This building has a floor space of 171,000 sq.ft. The model mine is situated nearly opposite the main entrance of the building and is easily identified by the tall headframe erected at the collar of the shaft. While the shaft is actually only 16 ft. deep, the slow-moving cage, with the aid of panoramas on two sides of the shaft, gives the illusion of having descended 200 ft. The panoramas are moved with sufficient speed to give the visitor the impression that the cage is moving rapidly. The panoramas illustrate a typical shaft, showing methods of cribbing and timbering, including the unlagged square sets. Two levels are shown, one at 100 ft. and the lower at 200 ft. At the lower level is shown a view of a crosscut just after a blast has been shot, giving the visitor the illusion of visiting a mine in actual operation. The several rooms on the bottom floor of the mine are occupied by exhibits from various properties including the Goldfield Consolidated, the Homestake, the Bunker Hill & Sullivan, the Copper Queen, and Jones & Laughlin Co. iron mines. The U. S. Steel Corporation and subsidiaries occupy the entire southern portion of the Mines and Metallurgy building, covering nearly one acre of space. Each subsidiary maintains its own section, but the whole is so arranged as to form a continuous exhibit of machinery, models, cabinets and photographs. These illustrate the products in every stage of manufacture and are assembled on a larger scale than ever previously attempted. Iron mining and lake transportation are features of the exhibit. The earliest installations used in the manufacture of iron and steel form interesting features compared with modern installations. A miniature mine location is shown, including shops, offices, clubhouse, and houses for employees. All the iron ranges are represented by samples of ore.

DENVER—Feb. 11

A Summary of the advances and pauses that have occurred in Colorado's metal mining is given by Dr. R. D. George, professor of geology and state geologist, Boulder, Colo., in a long article published in "The Commercial" of Denver. Answering the assertion frequently made to the effect that the state now affords no new fields for prospectors he says: "He [the prospector] carried on his search chiefly along stream courses and in the limited mountain areas which were bare of soil and but sparsely timbered. * * * Very large areas have never seen the prospector. Such regions are hard to prospect. * * * There are several sections in which the general geological and structural features are the same as those of Leadville. One of these, not yet carefully prospected, is large enough to make three or four Leadvilles." Doctor George deplores the way in which so many men have gone into mining, playing a luck-and-chance game with no advice from trustworthy engineers, placing wholly inexperienced men in charge of operations. Mismanagement, overmanagement, wildcatting, stock jobbing, all come in for scathing remarks. He then tackles the "depth bogy" and ridicules the notion so frequently propounded that "veins do not go down," saying, "there is good evidence that Cripple Creek will repeat the experience of Butte. It is criminal folly to condemn Colorado camps as shallow until some proof is at hand." He places the following factors as responsible for the recent dullness in Colorado mining: (1) Ignorance and unfounded impressions of the state's resources; (2) unbusinesslike methods; (3) wildcat promotion of the get-rich-quick variety; (4) transition from days of bonanza mining with its luck and chance, to staid, well-founded business methods; (5) dog-in-the-manger mining (?) men, who own prospects or mines of merit but are too lazy or shiftless to develop them and too greedy to sell or lease them on reasonable terms; their chief occupation is yarning about the good old days and kicking about taxes, while waiting for something to turn up; (6) state indifference and neglect; mining has been permitted to take its own course, whereas the state has done a vast amount to aid agriculture; now, however, the farmers need encouragement given to mining in order to build up a greater home market for their produce.

BUTTE—Feb. 11

An Increase in activity is being prepared for in the Butte mines and the smelting works at Anaconda and Great Falls. This revival is due mainly to the improved conditions of the copper market and the startling rise in the price of spelter. The latter not only has caused the Butte & Superior, the Elm Orlu and the Timber Butte companies to keep their output at the highest figure permitted by the capacity of the mills, but

it has directed the attention of the older companies, of capitalists, leasers and prospectors to the possibilities of other zinc mines in the Butte district, mines which in past years have yielded large sums of money from the silver ores. Prominent among the old mines to be reopened is the Alice, owned since 1910 by the Anaconda and idle since 1893. A number of men have been put to work on this property to retimber the shaft down to the 300-ft. level. It is understood that this is for the purpose of extracting large quantities of rich zinc ore supposed to have been blocked out in past days. The hoisting machinery has been put in order preparatory to retimbering the shaft, work which will require six weeks at least. In the meantime much of the old machinery is being removed to make way for more modern equipment. Between 175 and 200 men are engaged on the numerous claims and leases in that section of the Butte district containing the Alice mine. Many are shipping ore regularly, others are improving their properties with modern equipment. For the most part the leasers are working claims on the Salvador, the Moulton and the Alice properties. Others leasers are doing development work on the Magna Charta, the Baltimore and the Home Run with more or less success in uncovering orebodies. Another zinc property, situated in the residence district of Butte, is the Emma, owned by the Butte Copper & Zinc Co. It was last operated in 1906. At that time large quantities of zinc ore were encountered which could not be mined at a profit then. The company is now making efforts to raise the necessary capital for reopening the mine. The North Butte has acquired about 1200 acres of ranch land in Silver Bow and Deer Lodge Counties, two miles north of Gregson Springs. Large and valuable water rights were purchased with the land; this has started the rumor that the land will eventually be used for a smelting site after the company's contract with the Washoe works has expired. The Anaconda has increased its output by operating its Butte mines on a six-day basis, begun a fortnight ago and to remain in force until further orders. The January output was 13,700,000 lb. of copper, about 55 to 60% of the company's normal output. At Great Falls the Anaconda has started work on its copper-refining plant and expects to have 300 men employed by the middle of April. This will consist of two steel buildings faced with brick. It will cost about $1,000,000 and will be completed by Jan. 1, 1916. This enlargement will give the Great Falls plant a capacity of 10,000,000 lb. per month. At the Washoe works, construction work on the leaching and the sulphuric-acid plants is in steady progress, and extensive experiments are being carried on for the recovery of copper from the slimes by flotation processes.

SALT LAKE CITY—Feb. 11

Mining Taxation Changes are the subject of certain joint resolutions introduced in the present session of the state legislature. One of these mentions that no special taxes or exemptions shall be applied to mines or mining properties and such mines and mining property shall be taxed the same as other property. The logical result of this will be that the county assessors will fix an arbitrary cash value on every mine in the state. This would cause serious injury to the industry, which is already bearing its full share or more of the state taxation. Under the present system the mines are not assessed on their net proceeds, as the state board of equalization will not allow a deduction for such expenses as insurance, interest, taxes, office expenses other than that at the mine, legal expenses, or, in fact, any ordinary general expense, so that the mines are paying taxes on an amount greater than their net proceeds. A meeting of mining men was held at the Hotel Utah, Feb. 6, to discuss the proposed bills, R. C. Gemmell presiding. The resolution was analyzed and discussed. It was pointed out that no property could withstand such taxation. It would also have the effect of discouraging capital from investing in the state. A committee consisting of R. C. Gemmell, M. P. Braffit, C. N. Doolittle, John Hays and Walter Fitch was appointed to meet with the committee on taxation relative to the measure. Another meeting of mining men will be held in the near future.

PORTLAND, ORE.—Feb. 10

The Bureau of Mines is asking the legislature now in session for an appropriation of $50,000 to carry on the work for the next two years, but there is great fear among mining men that the bureau will be given up, since the members of the present legislature are pledged to a program of economy, and the new governor, a purely agricultural representative, has suggested that the bureau be abolished. Mining men all over the state are up in arms and trying to save the bureau, which during the last two years did good work in showing up the mineral resources of Oregon, and at an expenditure of only $37,500 out of an appropriation of $40,000 for the work.

JOPLIN—Feb. 13

The Pocahontas Mine, from which a rich body of soft-ground ore was mined during 1913 and 1914, and which was forced to shut down by the timbers' catching fire, will be unwatered and reopened by J. M. Short and associates. There is a large tonnage of ore remaining in the pillars and legs, which can be mined. After the fire the ground caved, filling all the old drifts. The system of mining the pillars and legs as outlined by Mr. Short will be to sink the shafts a few feet deeper than the old level, drift out under the floor of the old workings, tap the pillars from below and pull them to the lower level. This will require the driving of main haulage drifts, and from these drifts will be driven shorter laterals to each pillar. By employing this system of mining it will be possible to extract practically all of the ore remaining in the mine.

CHICAGO—Feb. 13

The Oro Belle Mine in California and the Tonopah Belmont Development Co. were involved in a transaction mentioned in the copper-country local press not long ago. Although it may not be generally known, the Oro Belle has been a Lake Superior undertaking from the start. The property, situated in the Hart mining district of California, was secured seven or eight years ago by Worth B. Andrews, a graduate of the Michigan College of Mines. While various people have interested themselves in the property at different times, certain ones have always been warm supporters of the mine, contending that it was a most promising property. Among these may be mentioned Prof. A. E. Seaman, head of the geological department of the Michigan College of Mines, who some time ago made an examination and report on the mine, and who now has an interest in it. From the start, work has been done underground and on surface in a systematic manner and to as great an extent as the funds available at any time would permit. For eight years Mr. Andrews and those associated with him in the enterprise have devoted their best efforts to development for the benefit of the stockholders, of whom there are many. The stock has never been listed on any exchange, so far as known, nor has any publicity ever been given to its operations. According to the press, the trasaction between the Oro Belle and Tonopah Belmont provides that the latter company shall have one year in which to develop the Oro Belle, at the end of which time it shall construct a mill of at least 50 tons per day capacity, and suitably equip the property for production, or shall install a mill and equipment of such larger capacity as the property may warrant. It is further reported than an aggressive plan of development has been outlined and that operations will be started by the Belmont company at the mine immediately. This is unquestionably good news for the Oro Belle stockholders, who have ratified the deal, and is testimony of careful, well directed exploration, unaccompanied by press exploitation.

HOUGHTON—Feb. 13

Production of refined copper from the Lake Superior mines will not be increased more than 2,000,000 lb. in February, notwithstanding the fact that every operating mine in the district is working full time. The labor situation is satisfactory despite rumors to the contrary. Two of the mines, Wolverine and Mohawk, announced an increase in pay dating from Feb. 1, and all the mines of the Calumet district are now paying practically the same scale as the Calumet & Hecla and subsidiaries, and all are working full time. While pay is not up to normal as yet, the policy of the district is to increase wages 10% when the metal market is established on a 15c. basis. This will be followed in the present case. Production of refined copper for the month of February probably will reach 15,500,000 lb.

TORONTO—Feb. 13

The MacLean Nickel Bill, introduced into the Canadian Parliament, Feb. 8, to prohibit the export of nickel during war time, was objected to by Premier Borden on the ground that being a measure affecting trade and commerce it should have been preceded by a resolution adopted by a committee of the whole. The objection was sustained by the Speaker, who ruled the bill out of order.

The Nickel Demand continues to be satisfactory, and the International has given orders to start the remaining blast furnaces at Copper Cliff and run them to capacity. This will give them six blast furnaces in operation, so that production will be about the same as before the war. The only department that will not be operated is the reverberatory plant. It is understood that the cost of blast-furnace operation has been greatly lowered during the past year. In addition to the Creighton mine, which has been operated steadily, the Crean Hill and No. 2 mines will be reopened, and only No. 3 will remain closed.

The Mining News

ALABAMA

GULF STATES STEEL CO. (Shannon)—Shaft which is being sunk to intersect Big seam now down 1900 ft. on angle of 50°. Shaft started in May 1913, will be about 2600 ft. deep when completed.

ALASKA

E. H. BARTHOLF and associates of Seward will erect stamp mill on property in Willow Creek district.

NO. 8 ABOVE, LITTLE ELDORADO CREEK (Fairbanks)—Effinger, layman, reports discovery of pay averaging $2.50 per sq.ft. of bedrock. Paystreak is narrow. Nugget worth $112 recently found.

ZIMMER & HANSEN (Chatanika)—These operators, laymen on Ward & Matthison ground in Chatanika Flats, have had much trouble with seepage water from old drift. Difficulty overcome by plugging hole.

ARIZONA

Cochise County

CALUMET & ARIZONA (Bisbee)—Hoatson shaft opened for active work again after August shutdown.

PHELPS-DODGE profit sharing plan in various districts, put into effect after wage-cut last year, by which employees received rebate on store purchase, to be discontinued now that wages are increased.

Santa Cruz County

GOLD COIN (Amadoville)—Wm. Carnett has given up lease on this prospect, as mill he installed failed to show encouraging amount of gold.

MINERAL HILL (Tubac)—Work on this shipper opening good body of ore. Ed Casteneda, owner, will start shipments during coming month.

GLOVE (Amadoville)—Sheehy Bros., owners, will start shipping from this zinc mine at once. Mine was worked by O. K. Mining Co. until war stopped shipments; negotiations for new lease fell through.

GRINGO (Patagonia)—A. W. Houcks, manager, has crew overhauling mill and unwatering shaft, milling will be resumed as soon as supplies arrive from Coast. Mill had long run at one time; now hoped to make operation permanent. Formerly some high-grade gold ore was taken out of mine, but intention now is to use mine run. Latest development of this vein was of value in putting large amount of ore in sight.

CALIFORNIA

Amador County

GRITTON MINING CO. (Volcano)—Contract to advance tunnel 50 ft. let.

Kern County

TUNGSTEN PROPERTY one mile south of Randsburg being developed by David Thompson, by driving at 80-ft. point.

SUNSHINE (Randsburg)—Rich vein of sulphide disclosed in Stringer district showing permanency and indications of widening out into greater orebody than expected. Recovery value of ore about $50 per ton.

BUTTE (Randsburg)—William Dissman, V. Belt, I. Duffy, operating under lease, now prospecting on 200-ft. level. Number of improvements will be made. Mine has always been good producer under leasing system.

RED ROCK CAÑON near Mojave attracting attention from report that Dave Bowman recently found a 10-lb. nugget of gold. This cañon and Last Chance and Nugget Gulch including Goler and Garlock placer grounds were among early producers of large values in placer mining. Believed ground has not been worked out, although occasional finding of large nuggets stimulates prospectors to look for other nuggets more than it induces investors to take hold and develop ground.

Sierra County

ELDORADO (Allegheny)—Another rich strike made at this quartz mine, Armstrong Bros. and Fessler Bros., owners.

KATE HARDY (Forest)—Shaft here to be sunk deeper in order to drift under six oreshoots found in upper works. Several rich pockets extracted two years ago. Indications that high-grade is coming into face of present drift.

NORTH FORK (Forest)—After four years of steady development work, overcoming many obstacles, this quartz mine has again come into prominence, with indications of permanency. Oreshoot first discovered in 1877 by gravel miners running bedrock tunnel, and $100,000 was taken out; 40-ft. shaft failed to show more gold and work was abandoned. North Fork Mining Co., having property under contract, ran 1000-ft. incline, then 700-ft. drift, before recovering vein. Upon sinking to depth of 75 ft., ordinary milling ore was found. After sinking 100 ft. farther and drifting 100 ft. to northeast, edge of rich shoot was struck. Vein there had turned over and pitched to east, as in Tightner vein, of which the North Fork is believed to be continuation. Near point of discovery "feeder" 2 ft. wide, carrying rich arsenical sulphides, joins main vein. Main vein has been crosscut for 8 ft. without striking foot wall. Assay average of samples taken at random, $250 per ton. Stamp mill will be erected in early spring. George F. Stone in charge.

COLORADO

Clear Creek County

GARDNER (Idaho Springs)—Development work resumed; mine being worked through Newhouse tunnel.

LINCOLN GROUP MINES CO. (Idaho Springs)—Main adit, near Two Brothers tunnel at head of Virginia Cañon, being cleaned out and retimbered. Adit will be advanced to intersect Ben Franklin vein. Drifting in progress on Lillie Bell vein, breast in 4 ft. of $5 ore. Company plans considerable new development. H. A. Wimbush president of company and LeRoy Diltz superintendent.

Gilpin County

FIFTY (Black Hawk)—J. B. Selvidge and Arthur J. Hoskin of Denver and Louis L. Davis of Elgin, Ill., have been inspecting this property that has lain idle six years; indications are they will soon place 80-stamp mill in service to treat custom ores.

CARR (Central City)—Randolph mill at Black Hawk has been remodeled by Arthur C. Most, manager, to handle Carr output by amalgamation and concentration. Machinery includes crusher, feeders, ten 750-lb. stamps of slow drop, two Gilt Edge concentrators, settling cone and two Wilfleys. Capacity 30 tons.

Lake County

PAGE TUNNEL (Leadville)—New bore, being driven to prospect and drain Prospect Mountain, now in over 350 ft. without finding solid formation. Much delay experienced in catching up timbers after frequent slides of wash, but work is proceeding.

RAINBOW (Leadville)—Leasing company of Colorado Springs men secured this property, contiguous to Ibex, three months ago. Under management of George Campion, drift driven at depth of about 200 ft. has encountered what may prove to be extension of Little Jonny vein. Where opened, vein is thin but rich. Will be developed by new level below point of discovery.

Routt County

COPPER KING (McCoy)—Orders placed for materials and equipment for 50-ton mill to treat 4% copper ore by crushing, leaching and electrolysis. Orebody is steeply pitching, 8-ft. bed of sandstone in Red Gorge. In zone of present development, disseminated copper minerals are carbonates. Incorporators of new company are A. W. Hille, John R. Wood and A. L. Briggs, of Denver. Spur built at Yarmony Creek on Denver & Salt Lake railroad to serve camp.

San Miguel County

MOUNTAIN FLOWER (Telluride)—Main crosscut adit in 1000 ft. and approaching Delta vein. Company plans erection of mill next summer to treat ore from veins now disclosed. One vein about 150 ft. thick runs $8. Another 22 ft. thick assays $5.

Summit County

JUANITA MINING & MILLING CO. (Breckenridge)—Validity of title to mining property secured through tax deed is ground for argument in suit brought against American Metals Co., of New York. Lanyon Zinc Co., lessees, removed from Country Boy mine of plaintiff certain lots of ore having net value of $67,000. Juanita claims tax title was void; Metals company demurs that mere possession of premises was evidence of clear title. Judge R. E. Lewis of Denver overrules demurrer.

Teller County

SOUTH BURNS (Victor)—Acacia company will erect fireproof buildings to replace shafthouse recently burned.

GRANITE (Victor)—Company has purchased Dead Pine mine, including all surface improvements.

HONDO (Cripple Creek)—Surface plant and improvements being installed. R. G. Mullen manager.

DRAINAGE TUNNEL—Flow of water averages about 8600 gal. per min. Work will be resumed on main heading as soon as El Paso surface plant is replaced, about Mar. 1.

VINDICATOR (Independence)—Construction will soon begin on new shafthouse at No. 2. This will replace plant recently destroyed by fire. Steel headframe ordered and new building will be fireproof.

DEXTER (Cripple Creek)—Construction of concrete foundations for new compressor plant well under way and new Leyner compressor has been delivered. Company hopes to have plant in operation within two weeks.

EL PASO (Elkton)—Reconstruction of buildings destroyed by fire a few weeks ago well under way. New compressor house will have brick walls and steel roof. Shafthouse will be fireproof throughout. Five sets of lessees at work on development.

BLUE BIRD (Altman)—Since securing lease, two months ago, John Price and Nelson Franklin have been prospecting ground heretofore neglected. Short crosscuts have been driven north from main shaft on each level from 12th to 20th inclusive and have disclosed one continuous, large shoot, full extent still unproved.

EMPIRE STATE (Victor)—Ward Bros., who are carrying on development work on seventh level of this Bull Hill prop-

erty, have opened body of ore 10 ft. wide. Several carload shipments made from new orebody which has average value of $19. Ore mined and shipped without sorting. Shoot now opened for length of about 200 ft.; about 100 ft. of untouched ground above level.

JERRY JOHNSON (Victor) — Erection of 50-ton mill planned to be ready about now, has been seriously delayed. Grading finished and orders for equipment placed but plant will probably not be finished inside of three months. Stated amalgamation will be included in treatment. .If so, it will prove interesting experiment, process having signally failed in district during early operations.

MICHIGAN

Copper

CENTENNIAL (Kearsarge)—Wages of underground employees raised to standard of other C. & H. subsidiaries, Feb. 1.

WOLVERINE (Kearsarge)—Work confined to Kearsarge lode mining. No exploration. Tonnage of rock running below average. Contents maintaining well.

OSCEOLA CONSOLIDATED (Osceola)—Production for February will total 1,500,000 lb. refined copper. By March it should reach 200,000 lb. more.

WHITE PINE (Ontonagon)—To commence milling rock within three weeks, unofficially reported. Has tonnage opened for four years. Looks good in rock content but officials not given to bugle blasting.

FRANKLIN (Demmon)—Operations confined to exploration of Allouez conglomerate which continue satisfactory. Occasional rock shipments sent to Point Mills plant of Calumet & Hecla.

ISLE ROYALE (Houghton)—Two additional shafts, No. 1 and No. 7, will be reopened this spring. No. 1 will require much repairing. Stamp mill rebuilding progressing rapidly; all inclosed now and machinery installation to commence soon.

MISSOURI-KANSAS-OKLAHOMA

TWIN CITY MINING CO. (Webb City, Mo.)—This company recently incorporated with a capital stock of $50,000 to mine lead and zinc. Incorporators, Geo. W. Moore, W. D. Burns and John Wingfield.

C. C. MONLUX MILL on Brinkerhoff land was completely destroyed by fire Feb. 1; loss partly covered by insurance. Mr. Monlux stated he would begin building another mill at once, larger and more modern than that destroyed. Property in Galena district.

PORTORIA MINING CO. (Galena, Kan.)—This company which leased New Century mill and 40 acres of mining land has 19 mines in operation now and keeps 300-ton mill going steadily one 19-hr. shift. One of best mines on tract operated by Fred Grester & Co. Mr. Grester recently purchased interest and installed steam hoist and other modern mining machinery in order to operate more profitably.

MONTANA

Silver Bow County

ANACONDA GUARD shot and killed Feb. 12 by Harry Robinson, vice-president of new Mine Workers' Union and an I. W. W. agitator.

GAGNON (Butte)—Serious cave in old inclined shaft resulted in death of Joseph Faber, J. R. Fay, Mike Zerc and Andrew Evison, and in slight injuries to Richard Tiddy and Richard Rodgers, who survived to tell story of accident. Cave occurred at 9 o'clock, Feb. 6, according to estimate of Rodgers, who looked at his watch at a quarter of 9. Shaft is 72° incline. Great mass of rock, about 10 sets long, fell from hanging wall, crushing timbers and carrying five men, who were retimbering, down some distance, where they were buried in mass of broken timbers and rock that plugged shaft. Fall occurred short distance above 1400-ft. level. Tiddy, though struck by rocks and timbers, escaped cave, extricated himself, climbed shaft ladder and reached level above. Only Zerc was killed outright. Fay and Faber died after many hours of frantic rescue work, when they were taken from débris. Rodgers and Evison were working two or three sets above floor of 1400-ft. level. Below them on floor were Faber and Zerc. Above them a set or two were Fay and Tiddy. Having been told by shift boss that ground was shaky, men took all possible precaution to brace it well and double-stull it. In spite of this, cave came without warning. Lights went out, air connections were broken and men were left in dark, with timber and rock jammed about them. Evison and Rodgers were standing on same plank when cave came. Rodgers was knocked down under footwall, Evison was down below him complaining of feeling numb. Tiddy was on same stage as Fay. Latter was knocked down but Tiddy got out. Supt. O'Neil, Foreman Dan Sullivan and force of miners started rescue work. This was slow for reason that quarters in shaft were so cramped by broken timbers and rocks that but one miner could work at a time. Moreover, there was imminent danger of further caving, compelling the rescuers to brace and shore shaft effectively as they removed the débris. Fay being near the top of slide, kept calling to rescuers that he was all right. By Sunday morning he was freed to waist of timbers and rock, but it was impossible to get him extricated until 9 that night after 24 hr. imprisonment. He refused food and hot drinks, and began growing weak an hour before he was rescued. He was still breathing when taken out, but soon died of exhaustion. Rescuers worked both from above and below, and Faber's body was taken out at noon Sunday. He was still alive when dug out of débris. His cries could be heard, but soon ceased. His death was caused by internal injuries, shock and exhaustion. Rodgers was not reached till 7 Sunday night, when he had been under débris 22 hr. He had frequently called to rescuers to hurry, but in spite of frantic efforts it was 10 hr. later when he was reached, given some warm coffee and removed to surface. Some time before, he had informed rescuers that Evison was probably dead, having ceased to reply to calls. Evison's feet were brought into sight a few hours after accident, but great mass of timbers and earth to be removed and difficulty and danger of task made extrication of his body slow. It was finally recovered Sunday night, found in standing position with chest crushed by timbers and rock. Body of Zerc was last one reached by rescuers, 63 hr. after accident. Was found in recess in wall timbers of shaft on floor of 1400-ft. level, in a sitting position with one arm around lunch bucket. He was evidently killed by falling timbers.

NEVADA

Clark County

ORE SHOWING VISIBLE GOLD in considerable amount recently discovered about 10 miles west of Platina by H. J. Jarman; numerous locations made in vicinity.

ORO MINGO (Platina)—Ore containing platinum discovered in this mine several months ago; considerable development work being prosecuted.

MOBILE (Goodsprings)—Property now shipping about 400 tons of zinc ore monthly, using aërial tram to deliver to foot of mountains, thence by motor truck to Jean.

ANCHOR (Goodsprings)—Shipments increased, owing to high zinc market; about three cars per week now going forward to Eastern smelters. R. W. Moore in charge.

NEW TOWNSITE, PLATINA, laid out near site of old town of Sandy. Several hundred people have come to new town, attracted by discoveries of high-grade gold-platinum ore in Boss and adjacent properties.

YELLOW PINE (Goodsprings)—Milling at full capacity will be resumed about Mar. 1. At present property ships monthly about 500 tons of high-grade zinc-carbonate ore, mill having been closed in November through accident to locomotive.

POTOSI (Arden)—New roasting plant in successful operation for past six weeks, treating 20 tons of zinc-carbonate ore daily. Oil now being used as fuel, expected capacity of plant will be considerably increased in near future. Property shipping about 800 tons of zinc ore per month.

FREDRICKSON (Goodsprings)—Property under bond to Dividend Mining Co., which is erecting dry concentrating plant, using Plumb jigs and Sutton, Steele & Steele tables, to treat mixed lead-zinc-silver ores developed in mine. Expected plant will be completed before Mar. 1.

GOLDEN SCEPTRE (Las Vegas)—Law-suit which closed property shortly after high-grade gold ore was discovered last summer, was settled at last term of court in favor of original owners, who will proceed with development. Opening of this property will add life to new town of Quo Vadis, started near mine shortly after discovery of ore.

BOSS (Platina)—Platinum-Gold Mining Co., which recently purchased this property from Boss Gold Mining Co., is erecting small plant for experimental treatment of gold-platinum ores. Understood experimental work is to be in charge of Pacific Platinum Works of Los Angeles. Force at mine increased, and property being rapidly developed. Copper ore being shipped, but all platinum ore extracted being held pending completion of tests.

Esmeralda County

YELLOW TIGER (Goldfield)—New compressor and motors will be in operation soon. Oreshoot assaying $50 opened on 700-ft. level.

LONE STAR CONSOLIDATED (Goldfield)—Hoisting equipment to be installed at two shafts; sinking to 700-ft. level will be done.

JUSTICE GOLD MINING CO. (Goldfield)—Company operating property of Goldfield Daisy Mining Co. under 2½-year lease. Shoot of high-grade ore opened on 265-ft. level of main shaft.

GOLDFIELD CONSOLIDATED (Goldfield)—Rumors that Aurora Consolidated was to be closed for three months emphatically denied by officials. Stated mill will be closed about 10 days for installing new filters.

GOLDFIELD CONSOLIDATED (Goldfield)—Treatment of mill tailings will begin soon; Lidgerwood cableway with steel towers and grab buckets installed for transporting this material from pond to mill. Development work in Mohawk mine progressing satisfactorily; several faces in good-grade ore. Stated Aurora Consolidated now operating at profit.

MERGER MINES CO. (Goldfield)—Drift run on 1265-ft. level of Goldfield Consolidated's Grizzly Bear shaft across northern end of St. Ives claim into Merger ground for exploratory purposes. Crosscut now being driven with expectation of cutting downward extension of Jumbo Extension oreshoot. Exploratory work will be resumed on 1330-ft. level.

ATLANTA (Goldfield)—Carload shipment of ore made from 1750-ft. level to Millers sampling plant of Western Ore Purchasing Co.; first shipment since resumption of deep-level work. In north drift on 1750-ft. level small oreshoots assaying $9 to $36 opened, most promising being 2-ft. shoot assaying $17. Ore in winze from southwest crosscut and raise from north drift of 1750-ft. level assays $15.

GOLDFIELD MERGER (Goldfield)—Action taken in San Francisco will delay for 20 days hearing in U. S. district court in Seattle on receivership. After series of conferences between Frederick Bausman, counsel for minority stockholders, and Henry M. Hoyt, counsel for George Wingfield, and C. O. Whittimore, of Los Angeles, stipulation signed by which both sides agree to postponement of hearing from Feb. 8 to Mar. 1. Carl N. Johansen, appointed receiver, will remain in legal charge until later date.

Humboldt County

MINNEHAHA (Rochester)—Oreshoot 7 ft. wide, 3 ft. of it shipping grade ore, opened recently.

LINCOLN HILL MINING & MILLING CO. (Rochester)—Stated ore worth $50,000 blocked out and development work progressing with satisfactory results. Two-stamp mill saving $6000 to $8000 in bullion monthly.

Lander County

PLACER STRIKES near Hilltop made in Mud Springs district and Crumb Cañon. On Nelson property, at latter

place, shaft sunk 60 ft. and pump installed; gold coarse and in nuggets.

AUSTIN-NEVADA (Austin)—Development work in Hiawatha tunnel progressing satisfactorily; oreshoot, opened on surface, cut and silver chloride exposed. Development work on deeper levels will be done; stated sufficient funds on hand for year's work.

Lincoln County

NEVADA-DES MOINES (Pioche)—New building for steam-boiler plant built.

Mineral County

HIDDEN TREASURE (Luning)—Property being examined for purchase. Stated milling plant may be built. Ore silver-lead.

SHIPPER COPPER CO. (Luning)—Development work will be resumed soon. Property chief producer of Luning district in past.

HILL MINE (Acme)—Property sold to Frank Everett of Luning. Stated 10-stamp mill will be built. Development work opened good tonnage milling-grade gold ore.

BOVARD & MENKE (Lappan Cañon)—Lease and bond on this gold property taken and work commenced. Shaft down 60 ft., will be sunk to deeper level before lateral development is done. Oreshoot 2 ft. wide opened.

Lyon County

SMITH VALLEY MINES CO. (Yerington)—Mine being examined by stockholders; property in hands of receiver.

WHEELER (Yerington)—Mill, operated by lessees, closed recently on account of continued cold weather. Development work continued.

NEVADA-DOUGLAS (Ludwig)—Foundations for leaching plant completed and work on tank building under way; tanks being assembled. Mine cars will dump into bins, ore then conveyed by belt to crusher and then by second conveyor-belt to leaching building.

Nye County

VALLEY VIEW (Manhattan)—From this new producer operated by Pannion & Anderson first milling made recently demonstrated good milling grade of ore mined by tunnel.

SEYLER HUMPHREY MINING CO. (Manhattan)—Recent small milling made by Wann & Reed, lessees on April Fool claim, shows average of $50 per ton. Lease has steadily netted profits of better than wages to its owners for more than two years of development work.

MONITOR-BELMONT MINING CO. (Belmont)—Brick machinery in operation and construction of milling plant progressing rapidly; expected to be in operation June 15. Mill will contain gyratory crusher, ten 1600-lb. stamps, 10x6-ft. tube mills for regrinding and Deister tables. Power line extension from Manhattan in operation. Ore said to assay 60 oz. silver and a little gold. Property in successful operation from 1864 to 1884 when costs were $40 per ton, silver then being over $1 per oz.

Washoe County

PRODUCTION FROM JUMBO DISTRICT, southwest of Virginia City, will be resumed in spring. Development work on several properties progressing with satisfactory results, and stamp mill will again be placed in commission.

STEAMBOAT SPRINGS MINING & DEVELOPMENT CO. (Reno)—Franchise granted company to lay pipes under streets of Reno to supply steam and hot water to residences and buildings.

White Pine County

OLD EXCHEQUER (Cherry Creek)—Work resumed at this silver property and shipments will be made soon. Was large silver producer in '70s.

OREGON

GRANTS PASS CITIZENS and mining people near that place making effort to get proposed custom mill in operation; said one can be constructed for $25,000 to $30,000, that will handle all ores available at this time.

HIGHLAND GOLD MINES CO. (Rock Creek District)—Circuit Judge Anderson of Baker overruled demurrer of Daniel Grabill, trustee, one of defendants in suit brought by Eastern Oregon Light & Power Co. and gave the defendant 10 days further in which to answer.

DEEP GRAVEL (Waldo)—This mine operated by H. L. Herzinger has just commenced operation at full capacity, preliminary work having made it possible for management to put through boxes double amount of dirt previously handled.

IMPERIAL MINE (Cable Cove Dist.)—Otto L. Simons recently secured bond and lease on this mine; understood arrangements are being made to operate. Mr. Simons arranged with C. L. Arzeno to take over active operation under lease. George Bailey mine superintendent.

LOGAN PLACER (Waldo)—J. R. Harvey returned from trip to this mine bringing last cleanup, which amounted to $9000. Mr. Harvey says that ditches in Waldo district are all running full of water and mining operations are being carried on at all placer mines with good results.

JOHN R. SMITH, who last year opened black sand deposits on South Inlet near Marshfield, reports finding big placer deposit near Agness postoffice. Is in San Francisco for machinery to work mine and showed in Marshfield over $3000 in coarse gold nuggets, taken from new discovery. Smith says find is in district where miners prospected 50 years ago and that he and his son took $3000 out in less than two months with only common miners' tools and in deep snow most of time. Mr. Smith still controls South Inlet black-sand mines and says he will put machinery on them this year.

ALMEDA MINING CO. (Galice)—New officers and directors for this company: Thomas J. Burley, Portland, president; Nat P. Ellis, Waverley, Ia., vice-president; H. Thurman, Portland, secretary and treasurer; S. C. Spencer, Portland; L. E. Crouch, Portland; C. C. Aler, Columbus, Ohio; G. A. Grossman, Waverley, Ia.; Oscar Young, Springfield, Ohio, and John F. Wickham, Portland, directors. Mr. Burley has paid up all debts of company, $89,000, since he was appointed receiver and application to county court has been made to discharge receiver and turn management of property over to new directors. Will be about 60 days before receiver can be discharged and during that time arrangements are being made for future operation of mine. New management will install concentrating plant with daily capacity of 200 tons. There is already smelting plant on property capable of smelting 100 tons daily. Service line to be built from mine to California-Oregon Power Co. plant, 16 miles, to bring in current. This line will cost about $1300 per mile. Improvements to be put upon property will amount to $75,000 and mine will be operated in businesslike manner in future.

SOUTH DAKOTA

ORO HONDO (Deadwood)—Station being cut on 1400-ft. level and auxiliary hoist on 1000-ft. level will be moved. Shaft down 1600 ft.

HIDDEN TREASURE (Deadwood)—Sinking continues; shaft has reached depth of 275 ft. Gasoline compressor and hoist are used.

DEADWOOD-HEIDELBERG (Deadwood)—Recent shipment to Golden Reward mill gave returns of $18 per ton. Several lower-grade orebodies were encountered in sinking shaft.

WASP NO. 2 (Flatiron)—Owing to heavy fall of snow only day shift being worked in mine. Cleanup for January shows ore averaging $2 per ton. As soon as weather conditions permit, operations will be returned to normal.

ECHO (Maitland)—Electric compressor set up and supplying air for two machine drills. Shaft house completed and heating plant installed. Electric hoist being added to equipment.

ANACONDA (Roubaix)—Removal of hoisting plant from old workings to new site completed; will be put in operation soon. Three-compartment shaft being sunk has reached depth of over 50 ft. Will be continued to 500 ft. and connections made with old workings.

PAHASA (Custer)—This and associate companies have conveyed to C. H. Kamman all rights and interest in properties situated in Pennington and Custer Counties. Property includes large acreage of lode ground as well as placer. Surface equipment consists of two 250-ton concentrating mills and several hoists and machinery. Some of most promising tin and lithia mines in southern Hills included in property.

UTAH

Juab County

EAGLE & BLUE BELL (Eureka)—About 80 ft. of work done on the orebody recently opened on the 1700 level. What is thought to be new body off of the main ore-channel found by crosscutting. Some of ore runs unusually well in lead and silver. Connections nearly completed between raise from 1700 and winze from 1550.

WISCONSIN

Zinc-Lead

WEIGLE (Linden)—Platteville-Linden Co. has been reorganized and will reopen this mine.

GLANVILLE (Linden)—Levi Pollard and Saxe Bros., Milwaukee, have taken over the old Glanville mine.

SMITH & SINGER (Linden)—Found good cuttings by churn drill and is sinking a shaft on the Smith and Heathcock land.

OPTIMO (Linden)—Has struck a rich deposit that is turning out raw concentrates assaying between 50 and 55% zinc.

CANADA

New Brunswick

LAKE GEORGE—This old antimony mine in York County is to be reopened. Was abandoned some years ago, as it did not then pay, but present scarcity and high price of antimony have changed conditions.

Ontario

SENECA SUPERIOR (Cobalt)—Declared the regular bimonthly dividend of 10%, regarding which there has been considerable speculation.

McINTYRE (Porcupine)—Treated 8125 tons of ore in January averaging $7 and recovered bullion valued at $55,581. Total costs $4.65 per ton.

LUCKY CROSS (Swastika)—Negotiations are under way to have this gold property reopened. It has possibilities as a low-grade mine.

DOME (Porcupine)—Milled 23,220 tons of ore in January, and recovered bullion to the value of $82,727. December production was $81,660 from 23,090 tons.

NIPISSING (Cobalt)—Earned $1,640,000 net in 1914. Ore reserves are 10,000,000 oz., largest in the history of the company. Annual meeting will be held in April.

REA (Porcupine)—Declared 6% dividend, first ever paid by this company. The mine is operated by a leasing company, and the original shareholders have a very small interest.

DOME LAKE (Porcupine)—Produced $11,000 in January, a total of $19,580 since mill started operations. Annual report shows capital of $1,000,000, $940,312 issued. The company owes Hudson Bay Mines $77,906. Proposed to double the mill capacity. Hudson Bay owns 600,000 shares of issued capital of Dome Lake.

The Market Report

Metal Markets

NEW YORK—Feb. 17

Copper, lead and spelter have all been stronger, but in each case the situation is confused. Tin has been stationary.

The Treasury Department has revoked the previous customs order demanding collectors of customs to keep secret for 30 days the manifests of outgoing vessels. The collectors were notified that they are to follow the same practice regarding the publicity of the manifests as was in effect prior to the issuance of the special order last October.

Copper—The market for this metal has been confused, uncertain and difficult to quote. The conditions attending shipments to Europe are in themselves sufficiently erratic to explain all uncertainties in the export business, and there are also uncertainties in the home trade. In the first part of our week of record scarcely any business was reported done. On Feb. 15 there were some rather important transactions for shipment abroad which were figured as netting the equivalent of 14.22½@14.25c., cash, New York. On the following day there developed some buying by American manufacturers, and as high as 14¾c., regular terms, was reported realized, but at the same time there were sellers at 14½@14⅝c., regular terms.

Reports in the newspapers of the foreign business in copper being put on a dollar basis are not quite correct. Certain producers have tried to put their business on that basis for some time back, and in certain cases have succeeded in so doing, but not generally. The ability to make the change has depended chiefly on whether it happened to be a buyers' market or a sellers'. Foreign sales in terms of cents per pound have been to customers in countries like Italy and Sweden, no English business having been otherwise than in sterling, so far as we know. It would be desirable if the whole export business in copper could be put on the basis of cents per pound, f.o.b., New York.

Copper sheets base price is now 19¾c. per lb. for hot rolled and 20¾c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is quoted at 15@15¼c., carload lots at mill.

The Department of Commerce reports copper exports for the week ended Feb. 6 at 9,714,979 lb.; the larger items being 5,376,203 lb. to Great Britain, 1,613,099 lb. to Sweden and 1,526,627 lb. to Italy. For the 10 weeks, Dec. 5 to Feb. 6, the total exports were 118,500,727 lb. metal and 1268 tons ore and matte. Imports for the week were 5,047,212 lb. metal and 817,716 lb. in ore and matte; 5,864,928 lb. in all, chiefly from Chile, Peru and Canada. Imports for the 10 weeks were 33,231,518 lb. in all forms.

Brass Prices were again advanced on Feb. 15, base prices as given by the American Brass Co. being as follows: Sheets, high brass, 17¼c. net per lb.; low brass, 18½c. Wire, high brass, 17c.; low brass, 18½c. Rods, high brass, 17c.; low brass, 19¼c. Tubes, brazed or open seam, 20⅞c. Angles and channels, 20⅞c. Scrap allowances are 11¾c. net per lb. for high brass; 12½c. for low brass.

Tin—Business has been very dull. There has been a nearly complete absence of inquiry and a general mistrust of the present market situation.

Shpiments of tin from the Straits in January were 5100 long tons, a decrease of 227 tons from last year.

Arrivals of tin concentrates in Great Britain in January were: Bolivia, 4188 tons; Nigeria, 447! South Africa, 308; total, 4943 tons, estimated as equal to 3042 tons fine tin.

Lead—Reports agree pretty well that domestic consumption of lead is poor, but that there is a continuation of an important demand from abroad, and the latter is the backbone of the market. It stiffened up to such an extent that on Feb. 16, the A. S. & R. Co. advanced its price to 3.85c., New York, but as to whether that advance is an indication of confidence in the market position, or was simply a market maneuver, opinions differ diametrically.

Late in December last, the Broken Hill mining companies made arrangements for the shipment of refined lead to Great Britain, the ore being smelted and the bullion refined at the Port Pirie works of the Broken Hill Proprietary Co. in Australia.

Spelter—Conditions described in our recent reports continue unchanged, but there has been a further advance in prices all along the line. A little spelter in lots of a carload or so was reported sold as high as 8⅝c., basis St. Louis, and may have sold even above that figure. There are nothing but stray and trifling lots of prompt spelter available anywhere, and these may command almost any price, according to the exigencies of the buyer. Transactions for wholesale tonnages were done for April-May delivery, realizing about 8¼c. Smelters are very anxious to make sales for April and later deliveries, but have a good deal of difficulty in finding buyers. Contracts calling for deliveries running from April to July, inclusive, were reported taken at 7¾c., while spelter has been sold for July delivery at 7½c. The situation is

DAILY PRICES OF METALS IN NEW YORK

Feb.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
11	4.83	48⅜	*14.15 @14.25	36¼	3.80	3.65 @3.70	7.92½ @8.67½	7.75 @8.50
12	.....	...	.....	..	....	3.65 @3.70	.....	7.75 @8.50
13	4.8238	48¼	*14.15 @14.25	36	3.80	3.65 @3.70	8.17½ @8.67½	8.00 @8.50
15	4.8163	48½	14.20 @14.30	36¼	3.80 @3.85	3.65 @3.70	8.17½ @8.80	8.00 @8.62½
16	4.7925	48⅜	14.30 @14.50	36	3.85	3.70 @3.75	8.17½ @8.80	8.00 @8.62½
17	4.8038	48⅝	14.40 @14.55	36	3.85	3.72½ @3.77½	8.17½ @8.80	8.00 @8.62½

*Nominal.

The quotations herein are our appraisal of the markets for copper, lead, spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business and 0.25 to 0.37½c. on European. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.: St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Feb.	Silver	Copper				Tin		Lead		Zinc	
		Spot									
		£ per Ton	Cts. per Lb.	3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
11	22 11/16	63¼	13.74	63¾	....	177	154¼	18 13/16	4.09	39¾	8.64
12	22⅝	63⅛	13.71	63⅜	....	174	153	18⅞	4.10	39¾	8.64
13	22 11/16	.....	.....	.....	.....	.....	....	.....	.....	....	....
15	22¾	63⅛	13.71	63⅜	....	178	155	19	4.13	39¾	8.64
16	22¾	63¾	13.85	.64	....	178	153½	19 1/16	4.14	39½	8.58
17	22⅞	63⅜	13.77	63⅜	....	176	154	19 3/16	4.17	39⅞	8.66

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10=2.17½c.; £15=3.26¼c.; £20=4.35c.; £30=6.52c.; £60=13.05c. Variations, £1 = 0.21¾c.

unparalleled, and is generally recognized as being dangerous. Sooner or later, however, there will be relief in the form of increased production.

Zinc sheets are quoted today at $12 per 100 lb. f.o.b. La Salle, Ill., less 8% discount. Usual extras charged.

According to Mr. McKelvie, president of the Butte & Superior, the ore contract with the American Metal Co. is based on $28 per ton of 50% blende delivered at smelteries when spelter is at 5c., with $7 per ton rise per 1c. rise in spelter, the argentiferous residuum being returned to the mining company. This corresponds to (T-8)—$14@16.80, the latter being the smelting charge—the lower figure corresponding to 5c., the higher to 7c. for spelter.

We have heard that a foreign buyer tried last Thursday to obtain 500 tons of spelter for February shipment, offering 8½c. per lb., and could not find any producer who could supply it.

The Butte & Superior Copper Co. is straining every effort to make the maximum possible production of zinc ore, and for the moment is naturally and wisely sacrificing maximum extraction for the sake of maximum production.

The disruption of the German Zinkhüttenverband was caused, in part, by the defection of one Dutch and one Belgian zinc-smelting company. The other members of the union, with the exception of the Weinmann Works in Teplitz, reorganized at Berlin Jan. 12, 1915, as the Zinkhüttenvereinigung. The new organization is to run until Mar. 31, 1916.

Through a mistake in proofreading the price of spelter at St. Louis for Feb. 6, 8, 9 and 10 was given at 7.22½@8.12½c. The correct figures are 7.62½@8.12½c. for those days.

Other Metals

Aluminum finds increased inquiry and considerable sales on contract, but only moderate new business—**Antimony** is still active and in good demand with sales both for domestic use and for export. Ordinary brands sell at 17¾@18c. per lb.; while 20@21c. is asked for Cookson's—**Nickel** is unchanged, ordinary forms being 40@45c. per lb., according to size and terms of order. Electrolytic, 3c. higher—**Quicksilver** continues strong and prices are advancing. Early in the week some negotiations were conducted on the basis of $55 per flask, but no sale resulted. Large dealers are quoting today $60 per flask of 75 lb., New York. San Francisco, $58 for domestic orders. London price is now £12 5s. per flask.

Gold, Silver and Platinum

Gold—A transfer of $2,500,000 gold from Ottawa to New York was noted last week. The gold was from the fund which the Bank of England established at Ottawa at the beginning of the war. Exchange on London has reached such a low point at New York that further transfers or imports of gold may be expected at any time.

Receipts of gold bullion at the Dominion Assay Office at Vancouver, B. C., in 1914 are reported from 1015 depositions, the total weight being 166,150 oz., and the total value $2,029,500. This shows an increase of $580,875, or 40%, in value over the preceding year.

Platinum—The market remains very quiet and sales are on a very moderate scale. Prices have still an unusually wide range, sales of refined platinum being reported at $38@42 per oz.; while hard metal is quoted at $45@49 per oz., according to quality.

Our Russian correspondent writes under date of Jan. 21 that since the New Year the market has improved. The State Bank now advances 23,000 rubles per pood on platinum held by producers and dealers at Ekaterinburg. The price there is 8 rubles per zolotnik—$30.08 per oz.—for crude metal, 83% platinum; none can be bought below that figure. In Petrograd no transactions are noted.

Silver—The market continues on a very narrow footing, but the undertone remains good and the price has shown an advancing tendency the past week. London closes at 22⅞d. bid for shipment. The Indian bazaars still continue active buyers.

Zinc and Lead Ore Markets

JOPLIN, MO.—Feb. 13

Blende, high price, $73; assay base, 60% zinc, $60@70; metal base, 60% zinc, $61@67; calamine base, 40% zinc, $40@46; average, all grades of zinc, $65.12 per ton. Lead, high price $49, base $47 per ton of 80% metal contents; average, all grades of lead, $47.27 per ton.

SHIPMENT, WEEK ENDED FEB. 13

	Blende	Calamine	Lead	Values
Total this week..	9,536,170	1,595,250	1,826,540	$405,580
Total this year...	70,881,760	6,564,990	10,658,180	2,330,250

Blende value, the week, $328,460; seven weeks, $1,973,870.
Calamine value, the week, $33,980; seven weeks, $106,810.
Lead value, the week, $43,140; seven weeks, $249,570.

PLATTEVILLE, WIS.—Feb. 13

The base price paid for 60% zinc ore was $68@69 per ton. No sales of lead ore were reported.

SHIPMENTS, WEEK ENDED FEB. 6

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	5,075,620	.....	509,600
Year	24,456,640	226,000	2,546,300

Shipped during week to separating plants, 4,045,920 lb. zinc ore.

Iron Trade Review

NEW YORK—Feb. 17

Business continues to improve slowly but the change from the lowest point is considerable, as shown especially by the Steel Corporation statement below.

Structural business is improving and orders are coming in more freely. There is quite a demand for plates and shapes for shipbuilding. Wire business is reported quite active.

The pig iron market also shows improvement. There is more call for foundry iron, and also a demand for basic. There are quite a number of inquiries for pig iron for export, but they have not resulted in much actual business so far.

The United States Steel Corporation reports unfilled orders on its books Jan. 23 at a total of 4,248,551 tons of material, an increase of 411,908 tons during January, and of 923,959 tons since Nov. 30 last.

PITTSBURGH—Feb. 16

The Carnegie Steel Co. is this week operating 65% of its steel-ingot capacity, against an average of 40% in December. Its plate mills are operating at fully 90% of capacity, but this is chiefly on some excellent orders for plates for oil tanks and oil and gas lines, which will soon be worked out. The Pittsburgh Steel Co. is operating in full, but is stocking considerable quantities of wire products. The American Sheet & Tin Plate Co. is operating 92% of its tinplate mills, but is stocking some of the product, against the usual spring rush for deliveries. Galvanized sheets have advanced over $10 a ton, but this is due altogether to the phenomenal advance in spelter and its scarcity.

The steel market is today in such condition that it is within the possibilities for it to experience a sharp further improvement, perhaps a veritable boom, and it is also quite within the possibilities for it to slump off again. On the one hand, the mills have no business ahead, and are making up their rolling schedules almost from day to day, so that while their present enlarged operations reflect the improved buying of late they would just as promptly reflect any decrease in buying. On the other hand, the increase in mill operations, by which the steel industry as a whole is now operating at fully 55% of capacity, against less than 35% in December, has occurred without there being any pronounced buying in any quarter, and without the railroads taking hold to any extent, so that there is plenty of room for further improvement. It is pointed out in some quarters that it requires time for the industry to limber up to operating at full rated capacity, and hat if a rate of 75 or 80% were reached deliveries would begin to fall behind and then buyers would probably rush to cover and restore their stocks, now at probably the lowest ebb in years. Even the ferromanganese situation may become so acute as to cause buying of steel to cover possible shortages later.

Pig Iron—Struthers furnace, which was making basic, is out for a few weeks on account of an accident. The Buffalo Union Furnace Co. at Buffalo is this week putting in an idle stack. On the whole there is no change in merchant pig-iron.

NEW YORK—Feb. 17

The general market has been rather quieter, but business is still on a moderate scale.

Arsenic—The market is dull and unchanged. Quotations remain at $3.75@4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is steady, about as usual. Prices have been again advanced 25c., and are now $5 per 100 lb. for carload lots and $5.25 per 100 lb. for smaller parcels.

Nitrate of Soda—Business is fair, but a little irregular. Quotations are 2.12½c. per lb. for spot and up to June 30; 2.07½c. for July-December, and 2.05c. for 1916 deliveries.

Assessments

Company	Delinq.	Sale	Amt.
Belcher Silver, Nev.	Feb. 8	Mar. 1	$0.10
Booth, Nev.	Jan. 25	Mar. 1	0.02
Brunswick Con., Nev.	Feb. 16	Mar. 9	0.01
Caledonia, Nev.	Mar. 8	Mar. 31	0.05
Carbonate, Ida.	Jan. 28	Feb. 28	0.001
Cedar-Talisman, Utah.	Feb. 8	Mar. 1	0.005
Clear Grit, Ida. (post.)	Feb. 9	Mar. 3	0.0015
Confidence, Nev.	Mar. 11	Mar. 31	0.10
Con. Virginia, Nev.	Feb. 24	Mar. 18	0.10
Emerald, Utah (three instal.)	.....	June 9	0.01
Gethin Le Roy, Utah (post.)	Feb. 16	Mar. 7	0.02
Index, Ida.	Feb. 27	Mar. 27	0.005
Indiana, Mich.	Feb. 4	.....	1.00
Iron King, Ida.	Feb. 18	Mar. 19	0.001
Jack Waite, Ida.	Mar. 1	Mar. 24	0.01
Keystone, Utah. (post)	Feb. 23	Mar. 23	0.02
King Pine Crk., Ida.	Feb. 12	Mar. 13	0.002
Majestic-Idol, Nev.	Dec. 15	Jul. 20	0.005
Manhattan Con., Nev.	Feb. 30	Mar. 1	0.01
Moonlight, Ida. (post.)	.....	Feb. 28	0.005
Nor. Bnkr. Hill, Ida.	Jan. 30	Mar. 6	0.002
Ophir, Nev.	Feb. 11	Mar. 5	0.10
Overman, Nev.	Mar. 8	Mar. 26	0.05
Pioche Coalition, Nev.	Feb. 10	Mar. 1	0.025
Reindeer-Queen, Ida.	Feb. 15	Mar. 8	0.003
Rescue-Eula, Nev.	Feb. 11	Mar. 22	0.01
Sheba, Utah.	Jan. 12	Feb. 24	0.05
Sierra Nevada, Nev.	Feb. 8	Mar. 2	0.05
Snowstorm, Ida.	Feb. 19	Mar. 22	0.003
Sunset Dev., Ida.	Jan. 18	Feb. 18	0.0025
Syndicate, Ida. (post.)	.....	Jan. 28	0.001
Tarbox, Ida. (post.)	Jan. 28	Mar. 11	0.0025
Tar Baby, Utah.	Mar. 5	Apr. 5	0.005
Tonopah Midway, Nev.	Mar. 12	Apr. 12	0.01
Torino, Ida.	Feb. 20	Mar. 20	0.001
Utah-United, Utah.	Feb. 20	Mar. 15	0.01
Verde May, Ida.	Feb. 1	Mar. 1	0 001
Wolf Mountain, Utah.	Mar. 15	Apr. 14	0.0015

Stock Quotations

Of interest in metallurgical-corporation financing is the announcement that the Lackawanna Steel Co. has placed an issue of $6,000,000 of 6% two-year notes to refund its $10,000,000 of debentures due Mar. 1. The remainder will be paid off from surplus earnings.

COLO. SPRINGS Feb. 16		SALT LAKE Feb. 16	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05½	Beck Tunnel	.06½
Cripple Cr'k Con.	.01	Black Jack	.09¾
C. K. & N.	.06½	Colorado Mining	.10
Doctor Jack Pot.	.10	Crown Point	.01½
Elkton Con.	.45	Daly-Judge	5.25
El Paso	1.66	Gold Chain	.09
Findlay	.02½	Grand Central	.60
Gold Dollar	.04½	Iron Blossom	.96
Gold Sovereign	.04¾	Little Bell	.10
Isabella	.16¾	Lower Mammoth	.06
Jack Pot	.08	Mason Valley	1.10
Jennie Sample	.02	May Day	.12
Jerry Johnson	.03½	Opohongo	.01½
Lexington	‡.009	Prince Con.	.31½
Old Gold	‡.01	Seven Troughs	.03
Mary McKinney	.31	Silver King Coal'n.	2.97½
Pharmacist	.01½	Silver King Con.	1.92½
Portland	1.15¾	Sioux Con.	.03
Raven B. H.	.03½	Uncle Sam	.05
Vindicator	1.28	Yankee	.07½

TORONTO Feb. 16			
Bailey	.01½	Dome Exten.	.06
Coniagas	4.50	Foley O'Brien	.15
Peterson Lake	.20	Hollinger	22.25
Right of Way	.02	Imperial	.01
Seneca Superior	1.00	Jupiter	.09
Silver Queen	.02½	McIntyre	.30
T. & Hudson Bay	30.00	Pearl Lake	.02
Timiskaming	.16	Porcu. Gold	.25
Wettlaufer-Lor.	.04	Preston E. D.	.01
Big Dome	6.00	Rea	.12

SAN FRANCISCO Feb. 16			
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.11	Belmont	3.62½
Belcher	.23	Jim Butler	.66
Best & Belcher	.06	Lone Star	.08¼
Caledonia	.22	MacNamara	.03
Challenge Con.	‡.05	Midway	.07
Confidence	‡.10	Mont.-Tonopah	.47
Con. Virginia	.06	North Star	.13
Crown Point (Nev.)	.19	Rescue Eula	.07
Gould & Curry	.03	West End Con.	.52
Hale & Norcross	.04	Atlanta	.26
Julia	.01	Booth	.30
Mexican	.44	C.O.D. Con	.06
Occidental	.84	Comb. Frac	.06
Ophir	.13	Jumbo Extension	.81
Overman	.06	Pitts.-Silver Peak	.12
Potosi	.02	Round Mountain	.40
Savage	.04	Sandstorm Kendall	.09
Sierra Nevada	.13	Silver Pick	.06
Union Con.	.24	Central Eureka	‡.25
Yellow Jacket	.28	So. Eureka	‡2.25

N. Y. EXCH. Feb. 16		BOSTON EXCH Feb. 16	
Name of Comp.	Clg.	Name of Comp.	Clg.
Amalgamated	53¾	Adventure	1
Am.Sm.&Ref.,com.	64½	Ahmeek	275
Am. Sm. & Ref., pf.	100¾	Alaska Gold M.	28¼
Am. Sm. Sec., pf. B.	78	Algomah	.50
Anaconda	27	Allouez	42½
Batopilas Min.	.50	Am. Zinc	21¾
Bethlehem Steel, pf.	104¾	Ariz. Com., ctfs.	4½
Chino	35½	Bonanza	.31
Colo. Fuel & Iron.	25¾	Butte-Ballaklava	2¾
Federal M. & S., pf.	26	Butte & Superior	46½
Great Nor., ore., ctf.	31¾	Calumet & Ariz.	54
Guggen. Exp.	50½	Calumet & Hecla	390
Homestake	115	Centennial	17
Inspiration Con.	18¾	Cliff	‡1
Mex. Petroleum	70	Copper Range	34½
Miami Copper	18¾	Daly West	2
Nat'l Lead, com.	49¼	East Butte	9½
National Lead, pf.	108¾	Franklin	5¼
Nev. Consol.	12½	Granby	69
Ontario Min.	2	Hancock	11¾
Phelps Dodge	‡175	Helvetia	.25
Quicksilver, pf.	1½	Indiana	3½
Ray Con.	17	Island Cr'k, com.	44
Republic I&S, com.	20	Island Cr'k, pfd.	88
Republic I&S, pf.	74	Isle Royale	21½
SlossSheffi'd, com.	25	Keweenaw	2¾
Sloss Sheffield, pf.	‡82	Lake	6¾
Tennessee Copper.	29¾	La Salle	4
Utah Copper	52¾	Mass	4¾
U. S. Steel, com.	43¾	Mayflower	4¾
U. S. Steel, pf.	104¾	Michigan	.60
		Mohawk	56½
N. Y. CURB Feb. 16		New Arcadian	5½
Name of Comp.	Clg.	New Idria Quick	‡3½
Beaver Con.	.26	North Butte,	23¾
Big Four	.08	North Lake	1¾
Blue Bell	.05½	Ojibway	‡.70
Braden Copper	6¾	Old Colony	4½
Buffalo Mines	.75	Old Dominion	42½
Can. Cop. Corpn.	1¾	Osceola	70½
Can. G. & S.	.04	Quincy	56½
Caribou	.50	Santa Fe	1¼
Chambers Feriand.	.12	Shannon	5¼
Con. Ariz. Sm.	¾	Shattuck-Ariz.	22½
Coppermines Cons.	‡1½	Superior	27½
Davis-Daly	1 1/16	Superior & Bost.	1¾
Diam'field-Daisy	.10	Tamarack	31½
Dia. Black B.	.04	Trinity	2¾
Ely Con.	‡.01	Tuolumne	.25
Florence	.61	U. S. Smelting	22
Goldfield Con.	1½	U. S. Smelt'g, pf.	41
Goldfield Merger	.25	Utah Apex	2
Greene Cananea	26	Utah Con.	10
Kerr Lake	4 11/16	Victoria	1¼
La Rose	¾	Winona	1½
McKinley-Dar-Sa.	.45	Wolverine	46¼
Mines of Am.	2½	Wyandot	.50
Mutual Min., pf.	‡2½		
Nevada Hills	.30	BOSTON CURB Feb. 16	
New Utah Bingham	‡ 7/16	Name of Comp.	Bid.
Nipissing Mines	5½	Alvarado	.70
Ohio Copper	.06	Bingham Mines	‡3¾
Oro	.11	Boston Ely	.12
Pacific Smelt	1/32	Butte & Lon'n Dev.	.20
South Utah	10	Calaveras	1
Stand'd Oil of N.J.	402	Calumet-Corbin	.12
Standard S. L.	1½	Chief Con.	.70
Stewart	1¾	Corbin	‡1
Tonopah	6¾	Cortez	.25
Tonopah Ex.	2½	Crown Reserve	.73
Tonopah Merger	.37	Eagle & Blue Bell	.80
Tularosa	.25	First Nat. Cop.	1
West End Ex.	.03	Houghton Copper	1½
Yukon Gold	2½	Iron Cap Cop., pf.	‡5
		Majestic	.14
LONDON Feb. 2		Mexican Metals	.13
	£7 12s 6d	Nevada-Douglas	.38
Alaska Tre'dwell	0 8 0	New Baltic	1¾
Camp Bird	0 9 9	Oneco	‡.60
El Oro	0 9 6	Raven Copper	.07
Esperanza	0 6 3	Smokey Dev.	.10
Mexico Mines	0 12 0	So. Lake	4½
Oroville	1 0 0	Tonopah Victor	‡.17
Philippine Dr.	0 11 3	Trethewey	.10
Santa Gert'dis.	1 3 9	United Verde Ext.	2 1/16
Tomboy	0 13 9		
Tough Oakes		‡Last Quotations.	

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	.....	28.357	26.573	.....
March	57.870	58.067	.....	26.669	26.788	.....
April	59.490	58.519	.....	27.416	26.958	.....
May	60.361	58.175	.....	27.825	26.704	.....
June	58.990	56.471	.....	27.199	25.948	.....
July	58.721	54.678	.....	27.074	25.219	.....
August	59.293	54.344	.....	27.335	25.979	.....
September	60.640	53.290	.....	27.986	24.260	.....
October	60.793	50.654	.....	28.083	23.199	.....
November	58.995	49.082	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	.....	65.259	.....	70.188	.....
March	14.131	.....	64.376	.....	69.170	.....
April	14.211	.....	64.747	.....	69.313	.....
May	13.996	.....	63.182	.....	67.786	.....
June	13.603	.....	61.836	.....	66.274	.....
July	13.223	.....	60.540	.....	64.955	.....
August	*	.....	‡	.....	‡	.....
September	*	.....	‡	.....	‡	.....
October	*	.....	‡	.....	‡	.....
November	11.739	.....	53.227	.....	*	.....
December	12.801	.....	56.841	.....	*	.....
Year	13.602	.....	61.524	.....	68.168	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	.....	181.556	.....
March	38.038	.....	173.619	.....
April	36.154	.....	163.963	.....
May	33.360	.....	150.702	.....
June	30.577	.....	138.321	.....
July	31.707	.....	142.517	.....
August	*	.....	‡	.....
September	32.675	.....	‡	.....
October	30.284	.....	‡	.....
November	33.304	.....	139.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	156.564	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	.....	3.937	.....	19.606	.....
March	3.970	.....	3.850	.....	19.651	.....
April	3.810	.....	3.688	.....	18.225	.....
May	3.900	.....	3.808	.....	18.503	.....
June	3.900	.....	3.810	.....	19.411	.....
July	3.891	.....	3.738	.....	19.051	.....
August	3.875	.....	3.715	.....	‡	.....
September	3.828	.....	3.658	.....	‡	.....
October	3.528	.....	3.384	.....	‡	.....
November	3.683	.....	3.585	.....	18.500	.....
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	19.079	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	.....	5.228	.....	21.413	.....
March	5.250	.....	5.100	.....	21.460	.....
April	5.113	.....	4.963	.....	21.569	.....
May	5.074	.....	4.924	.....	21.393	.....
June	5.000	.....	4.850	.....	21.345	.....
July	4.920	.....	4.770	.....	21.568	.....
August	5.568	.....	5.418	.....	‡	.....
September	5.380	.....	5.230	.....	‡	.....
October	4.909	.....	4.750	.....	‡	.....
November	5.112	.....	4.962	.....	25.016	.....
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.061	.....	22.544	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	.....	14.12	.....	14.08	.....
March	15.07	.....	13.94	.....	14.10	.....
April	14.90	.....	13.90	.....	14.13	.....
May	14.90	.....	13.90	.....	14.27	.....
June	14.90	.....	13.90	.....	13.96	.....
July	14.90	.....	13.90	.....	13.90	.....
August	14.90	.....	13.90	.....	14.08	.....
September	14.90	.....	13.90	.....	14.03	.....
October	14.84	.....	13.75	.....	13.97	.....
November	14.59	.....	13.43	.....	13.83	.....
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....